SCIENCE

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EDUCATIONAL COSTS

I

IN the treatment of the educational instition as an industrial organization several points of view may be taken. That one which looks upon the student as the product of the factory or plant will be here dismissed without discussion as inherently false and as based upon very superficial analogies. In a second light the student may be regarded as the customer who buys the product instruction—possibly education—from the factory of which the workmen are the teachers. These theories, which the present writer has discussed at some length in another place,[1] will be passed over, in order that consideration may be given to a third viewpoint as follows.

The product of the college *considered as an industrial organization* is instruction; instruction in Greek, in chemistry, in mathematics, in history, or in any other subject which is there taught. The workmen of the educational factory fall into two classes: the instructors constitute the class of paid workmen; the students the class of unpaid workmen who may be looked upon, in a way, as apprentices. The product, instruction, can not be made except by the cooperation of the two classes of workmen. The finished product is education, or *an* education.

The analogy between the industrial plant and the educational institution is by no means as close as is asserted by those who advocate the application of the principles of business management to the college. It may be doubted if there be any instance of

1 "The College as a Commercial Factory," *Educational Review*, December, 1913.

a factory which manufactures a product as intangible as the instruction of the educational plant, even though we neglect all the higher connotations of the word education and confine our attention to its lower and more utilitarian characteristics. Moreover, there probably exists no case of an industrial plant in which one class of labor pays a premium for the privilege of working for a limited period—three to six years—with the avowed intention of leaving the factory at the expiration of the term of service. There is no industrial plant which willingly and knowingly conducts its business at a loss; no business in which the product is never sold. Finally, it is impossible to conceive of an industrial plant in which, no matter how much of the product be disposed of, there still remains as much of the product in the factory as before.

II

For the sake of investigation, however, these discrepancies, these failures of analogy, may be overlooked, and we may proceed to the determination of costs on the hypothesis of a product, instruction; a class of paid workmen, the teachers; and a class of unpaid apprentices, the students, who pay a premium to the plant.

Adopting a usual classification of costs into (i) prime cost: workmen's wages and cost of raw material; (ii) works cost: prime cost *plus* the expense of shop production; (iii) total cost: works cost *plus* the expenses of administration and management; we may note that in the educational plant the second item is eliminated, and that there is practically no raw material.

Thus the items of cost fall into two classes: (1) Direct costs: salaries of the instructing staff. (2) Indirect costs: all costs except item 1.

But since the instructing staff is paid for both teaching and administration, item 1 must be subdivided into (*a*) Pay for instruction; the only direct cost. (*b*) Pay for administration; an indirect cost, and again subdivided into departmental and general administration costs.

Moreover, the various constituents of item 2 must be examined with care, in order that they may be properly allocated to different departments.

For purposes of illustration we shall assume a college of two departments, D_1 and D_2, with the following data. Department D_1 has 10 professors, salary \$3,000 each, serving 300 hours each per year; 10 associates, salary \$2,000 each, serving 400 hours each per year; 10 tutors, salary \$1,000 each, serving 500 hours each per year. Department D_2 has 5 professors, salary \$4,000 each, serving 250 hours each per year; 10 associates, salary \$2,000, serving 400 hours; 5 tutors, salary \$500, serving 500 hours each per year. The analysis of the data is given in the following table:[2]

TABLE I

Grade of Workman	Department	Number of Men	Hours of Instruction	Hours of General Administration	Hours of Departmental Administration	Cost of Instruction, Dollars	Cost of General Administration, Dollars	Cost of Departmental Administration, Dollars
Professor	D_1	10	1,000	1,000	1,000	10,000	10,000	10,000
	D_2	5	1,000	50	200	16,000	800	3,200
Associate	D_1	10	3,000	500	500	15,000	2,500	2,500
	D_2	10	3,000	500	500	15,000	2,500	2,500
Tutor.....	D_1	10	4,000	500	500	8,000	1,000	1,000
	D_2	5	2,400	0	100	2,400	0	100
Totals..	D_1		8,000	2,000	2,000	33,000	16,800	13,500
	D_2		6,400	550	800	33,400		5,800

The general administration costs—salaries of the president and other general administrative officers—amount to \$20,000 per year.

[2] This table of data is taken from the article in the *Educational Review* to which reference has already been made. The same article may be consulted for a tentative analysis of the several items of cost.

We shall assume that there are 200 students in department D_1 and 100 in department D_2. The two groups of students need not be mutually exclusive. A student may be doing work in both departments, or in one department only. The further assumption will be made that in department D_1 a student works 25 hours per week, in department D_2 20 hours per week, in classroom and laboratory. In addition, in department D_1 each student works 25 hours per week in preparation for class; in department D_2, 40 hours per week.[3] The year consists of 30 weeks, so that there are, in department

D_1, $50 \times 30 \times 200 = 300{,}000$ student hrs. per year.
D_2, $60 \times 30 \times 100 = 180{,}000$ student hrs. per year.

Finally, the tuition fee paid by each student will be assumed to be \$150 per year. With these data we may proceed to the determination of *costs per workman per hour.*

The writer does not know any equitable basis for the distribution of general administration charges. They are certainly not necessarily allocable in proportion to the number of students in a department, nor in proportion to the number of student working hours, nor in proportion to the number of hours of teaching. A small department may, from the nature of its work, require more administrative attention than a large one. On the whole it seems best, in the absence of exact information, to allocate the general administration costs equally to the several departments.

The general administration costs of our hypothetical college are, therefore (see Table I.), \$20,000 *plus* \$16,800, or \$36,800, of which \$18,400 are chargeable to each department. From this and from Table I. we compute Table II., which summarizes all the data.

[3] No account is taken of home or preparation work done by the instructing staff.

TABLE II

General administration costs ...	\$18,400	\$18,400
Departmental administration costs	\$13,500	\$5,800
Wages of instruction	\$33,000	\$33,400
Working hours, teachers	8,000	6,400
Working hours, students	300,000	180,000
Total working hours	308,000	186,400
Total costs	\$64,900	\$57,600
Tuition fees	\$30,000	\$15,000
Net costs	\$34,900	\$42,600
Net cost per working hour	\$.113	\$.229

III

Examination of the assumed data will disclose the fact that the D_1D_2 college is a rather costly institution. Department D_1 pays \$60,000 in salaries to 30 teachers, for 8,000 hours' instruction per year, for 200 students (there are 4,000 administration hours in addition) so that the average number of hours instruction per teacher per week is a little less than 9, and there are 6⅔ students to each instructor. In department D_2, 20 teachers receive \$42,500 for 6,400 hours to 100 students, or about 10 hours per instructor per week, with 5 students to each instructor.

That the cost per working hour is so low is due to the neglect of most of the items of overhead burden, such as rent, power, heat, etc. But as our object is to test what conclusions may be logically drawn from costs computed on a correct theory of accountancy, and as we have no intention of attempting to apply our present results in practise, the omissions are unimportant.

It will be noted that the cost per working hour is much greater in department D_2 than in department D_1. If, however, we do not analyze the salaries paid to the instructing staff into their components, and if, instead of dividing the administration costs equally between the two departments, we allot them in proportion to the number of working hours, the workman-hour costs of the two departments approach much

nearer to equality,[4] giving a net cost per working hour, department D_1, of 13.8 cents; department D_2, 18.8 cents; a difference of 5 cents as compared with 12 cents under the more careful analysis.

In other words, by neglecting the analysis of the elements of cost, and by failure to allocate the various items where they should be incident; that is, by dealing with "general averages" instead of with specific charges, the cost per working hour becomes more nearly uniform. Consequently, exact information as to actual departmental costs is lacking or disguised; a result in precise agreement with managerial experience in general. To be of practical value cost per workman per hour, in the educational factory, must be based upon exact and detailed analysis.

IV

Further consideration of one or two points in the above discussion is desirable. Objection may be made to the inclusion of time spent by the student-workman in study at home, outside of the factory. Unless we limit the product (instruction) to the actual imparting of information in the class-room, a view altogether too narrow even on a strictly utilitarian basis, it must be granted that this home work is as essential to the product as is the factory labor, the work in school. The fact of the work being done outside of the factory does not affect the actual overhead expense or wages of the plant. It is conceivable that the student-workman might spend his entire working time in the factory without change of results. That he spends 50 per cent. or more of his working time outside of the factory amounts simply to his paying an additional premium for his apprentice privileges in the saving to the factory of expense, heat, light, attendance, etc. Theoretically each department should be credited with the amount of this salvage; practically the saving is *nil* as the expense, with the exception, perhaps, of light and attendance, is continuous in any case. The weakness of the plan adopted consists not in the inclusion of the student-workman's outside time, but in the exclusion of the outside time of the teacher-workman. If this latter were included there would be a further diminution of the cost per working hour in every department.

A real weakness of the plan under discussion lies in the fact that the outside student work is unsupervised to some extent, and may not be up to standard. This weakness, however, is inherent in the whole work of the educational plant; but not more so, by and large, than in the industrial plant. If it could be assumed that the inside work were 100 per cent. efficient and that all examination papers were perfect, then the percentage obtained on an examination would measure the quality and amount of a student's outside work. If, still with perfect examination papers, it could be assumed that all outside work were 100 per cent. efficient, the examination percentage would measure the efficiency of the combined student and instructor factory work, but would not differentiate between the two. If it could be assumed that all outside and inside work were 100 per cent. efficient, then the examination percentage would measure the efficiency of the work of preparing the examination paper. This might be called an equilateral triangle of untenable hypotheses.

[4] Total working hours 494,400. Working hours, D_1, 308,000, or 62.3 per cent.; D_2, 186,400, or 37.7 per cent. Whence, general administration costs, D_1, 62.3 per cent. of \$20,000, or \$12,460; D_2, 37.7 per cent. of \$20,000, or \$7,540. Therefore, net costs, D_1, are \$12,460 + \$60,000 — \$30,000 = \$42,460; D_2, \$7,540 + \$42,500 — \$15,000 = \$35,040. Whence the net cost per working hour is, D_1, \$42,460 ÷ 308,000 = .138; D_2, \$35,040 ÷ 186,400 = .188.

However, this weakness is by no means an insuperable objection to the present point of view of educational costs. It is sufficient, at least until the whole subject of cost accountancy shall have been put on a more scientific basis, to do in the educational what is done in the industrial plant: to compute costs on the basis of the workman-hour, even if the efficiency of the workman can not be accurately determined nor all the labor be adequately supervised.

V

When the management of an industrial plant investigates the question of costs it is for the purpose of determining the exact cost of each article produced, in order that the selling price may be fixed and a profit assured.

The educational plant disclaims all intention of making a profit, and has no customer, nor any product which is sold. When the management of an educational plant investigates the question of costs what is its purpose?

It has been said that it is well "to compare the cost of instruction per student hour"—the cost per workman-hour—in one department with the cost in another, and that "high cost will call for explanation and justification." The former assertion may be accepted as true without accepting the latter as a necessary consequence. It is quite as logical to say that low cost will call for explanation and justification. The analogy[5] between the industrial plant and the educational institution would seem to be an *ignis fatuus* destined to lead the investigator wandering into the morass of logical inconsequence.

[5] "Analogy: a resemblance of relations; an agreement or likeness between things in some circumstances or effects, when the things are otherwise entirely different."

The {educational / industrial} plant makes {an intangible / a tangible} product {not to be sold / to be sold} at a profit. In the industrial plant, the lower the cost the greater the profit. Therefore, the {educational / industrial} plant should produce at the lowest cost possible. This would seem to be the argument. It may be allowed to stand on its own merits.

In the second place, there can be no valid comparison of the costs of widely dissimilar products. If an industrial plant makes tin cups at a cost of 25 cents and silver cups at a cost of 25 dollars per working hour, surely the high cost of the silver cup, *as compared with the tin cup,* does not call for explanation and justification. If in a factory, in a given number of hours, say one hundred, there are made 1,000 silver cups by 100 men at a cost of 25 dollars each, 100 silver flagons by 50 men at a cost of 100 dollars each, and a single silver ewer by one man at a cost of 500 dollars, the costs per workman hour are $2.50, $2 and $5 respectively. Now it may be perfectly true, as has been said, that "the principle of efficiency"—or the principle of economic common sense, for that matter—"demands that the expenditure be commensurate with the results produced." But whether the results be commensurate or not can not be determined by comparing expenditures only. Certainly it can not be said that expenditure and results are not commensurate in the case of the silver ewer *because* the cost per ewer working hour is double the cost per cup working hour. The results may be, for the cups a ten per cent. profit, or $2,500; for the ewer a 500 per cent. profit, or $2,500. Even if the profit on the ewer were only ten per cent., or $50, still the ewer might be a Cellinian masterpiece, which counts as "results" even in business. Mechanical engi-

neering may be costing 46 cents per working hour, English 18.2 cents. Either may be costing too much, or each too little. As for the results, the unfinished products, engineering instruction or English instruction, or the finished product, education, they still await measurement.

VI

Doubtless it would be well for the college to know exactly how it is spending, how it is losing, its money. What must be guarded against especially is the misuse of statements of costs, as well as inaccurate statements of costs derived from insufficient data and unscientific investigation. A determination of the cost per student hour, or per working hour, which does not separate salaries of the instructing staff into wages, general administration and departmental administration charges; which does not properly allocate to various departments costs of rent, power and other items; which makes no attempt "to apportion the overhead expense exactly, as would be done in a manufacturing business"—such a determination may, perhaps, be valuable and suggestive if applied to a hypothetical college, but is misleading and dangerous if applied to an actual institution for the purpose of deducing practical consequences and suggesting practical reforms.

There is no consensus of opinion as to what education is—except, perhaps, the widespread view that it is a failure—and no general agreement as to what it should be. It is, perhaps, unfortunate that so much attention is being given to the determination of the costs of this unknown quantity; unfortunate that, obsessed by the slight analogy between industrial and educational organizations, so many investigators and writers fail utterly to see the innumerable and insuperable differences between education and business. It is true that as yet but little harm has been done, but there are indications that if this tendency be not checked serious evil may follow.

The executive and administrative branches of the educational business are coming to be looked upon as its trunk and its roots. The college is coming to be looked upon as an establishment in which education is administered, not as a seat of learning, where knowledge is taught, scholarship fostered and wisdom diligently sought. The teacher is no longer looked upon as an essential part of education; he is no longer an individual, teaching in freedom and earnestness, but is simply one of a numerous class of underpaid workmen whose betterment is impossible and whose usefulness is doubtful. In investigating the costs of the educational institution it will be well to count these costs of education treated as a business, and to take heed lest academic liberty be sacrificed to executive demands; lest truth be sacrificed to expediency.

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FLOOD PREVENTION AND ITS RELATION TO THE NATION'S FOOD SUPPLY

The problem of preventing the enormous losses from floods is one of the greatest before the American people. It is second only to that of increasing the nation's food supply and thereby decreasing the cost of living. That the two problems are closely related will be seen from the following facts and figures taken from statements made by experts who have not been contradicted.

These few facts, which have been culled from a mass of overwhelming evidence should convince every reasonable person—

First: That the federal government's present policy of river regulation is wrong.

Second: That a better policy is possible and is now under consideration by Congress.

Third: The necessity for the immediate adoption of the new policy.

The present policy of building levees only is radically wrong because it ignores the necessity of preventing flood conditions, and is

confined to efforts to protect the banks of the river from overflow. In this the levees have failed. For although the government appropriates millions of dollars for such work, we nevertheless continue to have floods, causing the loss of many lives and the destruction of property valued at more than 100 millions of dollars a year averaged over a ten-year period. This levee system has also been tried on the Hoang Ho in China for thousands of years, and has failed there.

In this country the damage done by floods has been appalling. You remember well what happened at Dayton, Ohio, this year. You remember the photographs showing the terrible conditions in that city. The same conditions have caused heavy damage in *other years,* at other places. Pittsburgh, Cincinnati, Memphis, New Orleans, have all suffered. These cities are all in the Ohio and Mississippi River basin. Other rivers have overflowed and caused great damage without attracting so much attention.

The government by allowing flood waters to accumulate and rush towards the sea during the season of freshets and melting snow permits the food-producing power of the country to be reduced. This reduction results from three different processes.

First: The upland is robbed of moisture that is greatly needed by maturing crops.

Second: An enormous amount of valuable top-soil is lost by erosion.

Third: The lowlands are drowned. While the lowlands are much less in area than the uplands, their possible producing power is far greater per acre. In fact, they are the richest lands in the world. The loss from erosion is beyond computation.

Under the present policy of building levees only it is admitted that the banks of the Mississippi between Cairo and Donaldsonville *cave* in each year to the extent of 9½ acres a mile for a distance of nearly 1,000 miles. Each year, therefore, nearly 10,000 acres of the best land in the world is deliberately surrendered to the floods. Engineers when building the levees place them back as far from the edge of the river as they think will be necessary to last 15 or 20 years. Is that a business-like proposition? It is estimated that *1,250,000,000* tons of silt are deposited annually in the Mississippi River. Of this amount 600 million tons flow out through the mouth of the river and *650 million* tons remain to fill up the channel. This 650 million tons is 2½ times the amount excavated in digging the Panama Canal.

It should be borne in mind that this enormous damage by soil erosion applies not only to the farms that lie adjacent to our great rivers, but that a very larger percentage of the six million farms in the United States suffer great losses from soil erosion, and a consequent decrease in production. It should also be noted that under the present methods the navigation of the rivers in the upper reaches is almost impossible during the seasons of drouth. In fact, there are times when there is scarcely enough water for sanitary drainage. The *storage reservoir system* would assure navigation throughout the dry season.

The facts and figures above quoted show how important it is to conserve all precipitation. That this can be done has been conclusively demonstrated in different sections of the country. Col. Freeman Thorpe, of the Minnesota Horticulture Society, who owns a large experimental farm near the headwaters of the Mississippi River, has allowed no water to run off his farm for 17 years. His farm consists of cultivated land, pasture and forest. His methods are extremely simple and inexpensive, consisting chiefly of contouring and embankment work, the effect of which has been to *double the annual growth* of *trees* in his forest, more than *double the capacity of the grazing land,* and add largely to the productivity of the cultivated land.

Col. Thorpe declares that there are over *300 million acres of land* now *idle* on the great central plateau of the United States for the want of sufficient rainfall. This, he says, would be the best soil for scientific farming, if we compelled the *filtration into* the *soil of all* the *limited* precipitation. In other words, if the *actual* precipitation were conserved all this land would be available. Professor Waite, of the Department of Agriculture, owns a farm between Washington and Baltimore,

where he has worked along the same lines with results similar to those secured by Colonel Thorpe in Minnesota.

Government officials report that the cultivable land of the United States is capable of producing sufficient food to supply a billion people. If that is true why does the country actually suffer because of the scarcity and consequent high price of food. The main reason is a lack of water due to waste.

I shall now outline the *new* policy for which there is an insistent demand from all parts of the country. This new policy is based upon the old and wise adage that an *ounce* of prevention is worth more than a *pound* of cure. The policy to which I refer is proposed by U. S. Senator Francis H. Newlands and is now before Congress as the Newlands Bill. Briefly stated the main object of this bill is to *prevent* the swelling of the rivers and the waste of water during the period of freshets, by the construction of reservoirs along the source streams and also diversion canals for irrigating purposes and for raising the underground water level.

The details of the plan are to be in accordance with agreements between the federal and state governments and such corporations and individuals as may hold vested rights in the matter. The watershed of every river and stream will be protected. And it is proposed that the work shall be done by the engineers who have charge of the work at Panama.

That the nation's supply of water is of vital importance will be seen from the following figures. The amount of water required by the average soil for full productivity is 60 inches each year. How far short of this required amount the actual precipitation of rain and melted snow is, will be seen from the reports of the Weather Bureau.

Weather Bureau experts divide the United States into three districts. That portion lying east of the states of Kansas and Nebraska is called the eastern or humid section. In this section the annual precipitation is about 48 inches, or four fifths of the amount required. It is estimated that 30 per cent. of this 48-inch precipitation is allowed to go to waste. The soil, therefore, receives benefit from only a trifle more than half the amount needed.

The next section comprises the states of North and South Dakota, Nebraska, Kansas, Oklahoma and Texas and is called the median or sub-humid section. In this all-important section the total average precipitation is only 30 inches. This amount is supplemented, we are told, by natural sub-irrigation from the mountainous country farther west. This sub-irrigation does not average, however, more than 5 inches. It will therefore be seen at a glance that every drop of water falling in that section should be utilized if possible.

The third section is that part of the country lying west of the median states and is called the westward or semi-arid section. The rainfall here averages only about 12 inches, or one fifth of required amount. Comment concerning waste of water in this section is superfluous.

Let me now quote from another official report which clearly indicates the importance of water. This report issued by the government, after referring to the fact that growing plants require nearly 1,000 times their weight of water says:

> A pound of bread is the equivalent of two tons of water used by the growing grain; and a pound of beef the equivalent of 15 to 30 tons of water consumed by the animal, both directly and indirectly through feed. So that the adult person who eats 200 pounds each of bread and meat in the course of a year consumes something like one ton of water for drink, 400 tons for bread and 4,000 tons for meat, making 4,401 tons of water in all.

The question of conserving the water supply of the country is therefore second to none and the federal government could do an immense amount of good by publishing and conspicuously displaying in every post office, railroad station and schoolhouse in the United States, charts and photographs showing and explaining the method of contouring and embankment employed by Colonel Thorpe and Professor Waite, and warning farmers, planters and other landowners to conserve all precipitation.

The secretary of the National Reclamation

Association, Mr. Walter Parker, of New Orleans, declares that there are ten million acres of land in the upper Missouri River basin that could be sufficiently irrigated to yield a crop of hay worth more than one hundred million dollars each year. This land would require no seeding, only water. A kind Providence has furnished the soil and placed the seed in the soil and sends sufficient rain and snow to germinate the seed and support the growing plants. It only remains for man to utilize the precipitation, and receive the benefit.

You are urged to consider the above figures in connection with the present high cost of food. This high cost of food is undoubtedly due to the fact that millions of acres of land are producing nothing, while hundreds of thousands of farms in all sections of the country are producing only a fraction of the possible productivity, owing to the lack of water. It should also be noted that the construction of dams and reservoirs would also result in a large development of hydro-electric power. This increase of electric power should decrease the cost of production and should therefore be a contributing factor in decreasing the cost of living. The Newlands Bill recognizes the absolute necessity of conserving the food supply of the nation, which food supply is in such imminent danger from waste of water and from waste of soil by erosion. It would therefore seem that the bill is one that every person who is interested in the cost of living should urge their representatives in Congress to support.

We are told that the chief opposition to the Newlands Bill comes from the railroads. If this is true, the railroads have adopted a very unwise and short-sighted attitude. All fair-minded people realize and concede that the railroads are by far the most important industry of the country. Personally, I believe that the federal government should do all that it properly can to promote the safety, solvency and prosperity of the railroads. But the railroads would not suffer by the adoption of the Newlands plan, for the reason that they would gain through the increased productivity of the soil far more than they would lose through competition with water transportation.

Among those who recognize the importance of a new policy that will prevent this enormous waste of water and soil are President Wilson, ex-Presidents Taft and Roosevelt. The Congress of Governors which met at the White House in 1908 also strongly endorsed the new policy, which is splendidly stated by a Philadelphia newspaper, from which I quote as follows:

> We must prevent floods. We can make use of the natural reservoirs which nature has provided for the absorption of rains, and we can create artificial reservoirs for the storage of flood waters, as we are now doing on the Panama Canal. The natural reservoirs are the forests and the agricultural lands which absorb the rainfall and the melting snows. Our aim should be everywhere to increase the porosity and absorbent properties of the soil and thus prevent run-offs, which swell our streams into great floods, which now aggregate a damage upon property of the stupendous sum of nearly 200 millions a year in the United States.

We have land enough to produce food sufficient to supply a billion people. But we can supply nothing without water. Wastefulness is our national sin. Wastefulness of men, of time, of money, and of our great national resources, but I believe the figures I have quoted prove conclusively that we can not afford to continue to waste water. In conclusion, attention is called to an old saying to the effect that if each before his own door would sweep, the village would be clean. Let me paraphrase this by saying that if each and every farmer, planter and landowner would prevent the wasteful run off of water from his land, there would be no more floods or danger from floods, and the land would be so benefited that its value would be enhanced to an amount many times greater than the cost of operation, and the entire nation would benefit to a degree beyond computation.

JUDSON G. WALL,
Chairman of the Committee on Soil Erosion of the Social and Economic Section of the American Association for the Advancement of Science

Note.—Since the above was written the United

States Department of Agriculture has decided to make a special study of the methods adopted by Colonel Thorpe.

A NOTABLE BOTANICAL CAREER

I HAVE before me the "Report of the Botanist" to the Regents of the University of the State of New York, bearing date of January 1, 1868, covering less than two pages, and signed by Charles H. Peck. There is internal evidence that his services began July 1, 1867, the writer reporting what he had accomplished in the half year since that date. A year later the "Report of the Botanist" covered about 80 pages and included a short general statement followed by (*A*) List of Species of Which Specimens Have Been Mounted; (*B*) Plants Collected; (*C*) List of Species of Which Seeds Have Been Collected; (*D*) Specimens Obtained by Contribution and Exchange; (*E*) Edible Fungi; (*F*) Species Growing Spontaneously in the State and Not Before Reported. This general sequence of topics has been characteristic of the long line of annual reports that followed these made forty-six years ago.

The latest report in this series was issued September 1, 1913, and was entitled the "Report of the State Botanist for 1912." Like its predecessors in recent years it contains an introductory general statement followed by (*A*) Plants Added to the Herbarium; (*B*) Contributors and Their Contributions; (*C*) Species not Before Reported; (*D*) Remarks and Observations; (*E*) New Species of Extralimital Fungi; (*F*) Edible Fungi; (*G*) Poisonous Fungi; (*H*) *Crataegus* in New York. Four plates (of fungi) and an index complete the pamphlet of one hundred and thirty-seven octavo pages.

As one looks back over this long series of reports, all from the hand of one man, Dr. Peck, he is powerfully impressed with the thought of what such a life of scientific activity has meant for the development of one branch of knowledge in North America. I was a young teacher just entering upon the work of enumerating the plants of Iowa when these reports began to appear, and remember with gratitude the help they gave me, and the still more helpful correspondence which beginning then has continued to the present. And this is not an individual experience, as may be seen by running over the lists of those who sent their difficult specimens to him for determination, and reported by him under the heading of "Contributors and their Contributions." The younger botanists of to-day have grown up with an abundance of books on the fungi, and with competent mycologists in so many of the colleges and universities that it has been as easy for them to learn the names of the fungi as of the flowering plants. They have not found it necessary to send their specimens to a far-away specialist for determination. So we should not expect them to have the same feeling with regard to a career like Dr. Peck's, as those of us have whose work began half a century ago. Yet for their sakes we may well pause here to enumerate some of the principal things in this man's life.

Charles Horton Peck was born March 30, 1833, at Sand Lake, N. Y. He graduated from Union College in 1859, with the degree of bachelor of arts, and later he was given the degrees of A.M. and D.Sc. by the same institution. For several years (1859 to 1867) he followed the teacher's profession, first in the Sand Lake Collegiate Institute, and later the Albany Classical Institute. Then he began his real life work as botanist for the New York State Museum, at Albany, and this has continued until the present time.

And now while we write the saddening word comes of such increasing physical infirmities due to advancing years as may well require him to rest from his long years of labor. There are to-day many botanists all over the country who will read this latest report with old-time interest, added to a personal regard for the veteran who has long occupied so prominent a place in the botanical field. It is given to few men to prepare such a report as this latest one at the age of four score years. It is the fortune of few to have erected so notable a monument as he has in the series everywhere known as "Peck's Reports."

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

M. ALBERT LACROIX

AT the meeting of the Paris Academy of Sciences, held June 7, M. Albert Lacroix was elected perpetual secretary for the class of physical and natural sciences, by 37 votes against 22 cast for M. Ternier, his only opponent. This merited honor will afford the greatest satisfaction to the many friends and admirers of Professor Lacroix. Still comparatively young for a scientific man (he was born in 1863) M. Lacroix began his special career in the petrographic laboratory of the Collège de France, and soon published, in collaboration with M. Michel-Levy, a valuable study entitled: "Les mineraux des roches." His great work "La Mineralogie de la France et des ses Colonies," has just been completed, and ensures to the writer a foremost place among the mineralogists of the world. Special studies on the granites of the Pyrenees and their contact phenomena, as well as the invaluable records of his investigations when sent in 1902 by the French government as director of the mission to Martinique after the fearful disaster from the eruption of Mont Pelee, constitute additional titles to high consideration. In the course of the Martinique expedition, M. Lacroix more than once exposed his life in the interests of science, notably on one occasion when, while in the flames of the death-dealing mountain, an emission of poisonous vapor passed within a hundred feet of where he was standing, destroying everything in its passage. Fearlessly utilizing this terrifying spectacle in the interests of science, the undaunted explorer photographed the phenomena, thus preserving a unique record of the appearance. He has explained that this "burning cloud" was the result of a formidable explosion, that it might, indeed, be regarded as a sort of projectile hurled out by the mountain, half-solid, half-gaseous, of very high temperature, and which in contradistinction to most volcanic emissions of vapor, although thrown up vertically into the air, descends upon the slopes of the volcano, under the duplex influence of the initial explosion and of the force of gravity, and sweeps everything before it. Its speed often exceeds fifty meters a second, and its convolutions are so dense and closely bound together and its outlines so clearly defined that only a few meters separate the zone of total destruction from that in which nothing is harmed.

The election of M. Lacroix as a member of the Academy of Sciences in 1904 was a fitting recognition of these and other labors in his special field. In 1906 he was entrusted with another mission for the study of volcanic phenomena, Vesuvius being this time the chosen locality. At present M. Lacroix has the professorship of mineralogy in the Museum d'Histoire Naturelle, and his laboratory in that institution is a favorable resort for all French explorers who are investigating the mineral riches of France or her colonies. The unfailing courtesy and amiability of the distinguished mineralogist contribute not a little to the advantages derived from a visit to the scene of his activity.

K.

THE LASSEN ERUPTION

A REPORT forwarded to the U. S. Geological Survey, Washington, by geologist J. S. Diller reads in part as follows:

Mount Rainier and Mount Shasta, the beautiful cones so much in evidence to the traveler on the Pacific Coast north of San Francisco, are now finding an up-to-date rival in Lassen Peak, which is plainly in view from the railroad for many miles in the Sacramento Valley between Redding and Red Bluff. Lassen Peak is the southern end of the Cascade Range, and it stands between the Sierra Nevada on the southeast and the Klamath Mountains on the northwest. Its lavas erupted in past ages reach the Sacramento Valley on the one side and on the other form a part of the vast volcanic field, one of the greatest in the world that stretches far across California, Oregon, Washington and Idaho to the Yellowstone National Park.

Of all portions of the Cascade Range Lassen Peak still retains the largest remnant of its once vigorous volcanic energy. Morgan and Suppan Hot Springs and Bumpass Hell on

the south as well as Hot Springs Valley and the boiling mud-lake Tartarus on the southeast have long attracted the attention not only of Californians but to some extent of the tourists, to whom the region is growing more accessible every year. If to these already established attractions be added a frequent occurrence of the recent volcanic plays of Lassen Peak the region will take high rank among nature's wonderlands.

But what is the nature of this new activity of Lassen? Is it really volcanic? Will it soon dwindle and become wholly quiescent or on the other hand is it the precursor of a more profound eruption like that of Krakatoa? The excellent photographs that have been taken of the outburst, especially those by G. F. Milford and the series by B. F. Loomis, of Viola, taken from a point six miles northwest of Lassen Peak, leave little doubt in the mind of any one familiar with volcanic phenomena that the outburst is essentially volcanic. These photographs are strikingly similar to those taken by Johnston-Lavis showing the progress of an eruption in the Lipari Islands, whose volcanic character is well known.

The eruptions of Lassen Peak began May 30 at 5:30 P.M., with an outburst of steam which, according to Forest Supervisor W. J. Rushing, continued about 10 minutes. It formed a crater in the snow-covered summit of Lassen about 25 by 40 feet in extent and covered the encircling snow for a distance of 300 feet with a mantle of dark wet dust. Harvey Abbey, a forest ranger, visited the scene and reported the facts.

On the following day at 8 A.M., another eruption occurred and on June 8, a week later, the third and much larger outbreak took place. It lasted 30 minutes and the rolling column of dense black smoke rose to the height of 2,500 feet. Stones were hurled from the crater and the forest service outlook house, a quarter of a mile away on the tip-top of Lassen Peak, was broken by some of them. Blocks and smaller fragments accumulated about the crater to a depth of several feet. The dust and sulphurous gases carried southward by the wind were observed at Mineral, the forestry station, and the dust was noted 5 miles beyond. Forest rangers who were in the neighborhood of the summit during the eruption heard the rushing steam and the falling rocks but report no rumbling or subterranean noises, earth shocks, electrical phenomena or great heat beyond that of steam. The dust was practically cold when it fell. Considerable volumes of water were ejected probably wholly in the form of steam. The water condensing from this steam washed a gully in the snow to the adjacent lakelet which occupies what prior to this latest eruption had long been regarded as the youngest crater of the Lassen volcano. The new crater is not quite over the throat of the old but is a few hundred feet to the northwestward.

In all there have been eleven eruptions up to the date of this report—June 21. The most violent was at 9 A.M., June 14, when several over-venturesome persons were injured by falling or rolling stones. The eruption was visible from the Sacramento Valley nearly 40 miles away and created profound interest. The subsequent eruption on Friday, June 19, was of relatively small energy. Mr. Rushing reports that eruptions are generally, if not always, preceded by a complete cessation of escaping steam.

With successive eruptions the new crater is enlarging. June 20, when Mr. B. F. Loomis and I visited it, it was 400 feet long and 100 feet wide with a depth of not over 100 feet. It appears to follow a fissure running a little north of east and south of west. The escaping steam from the southwest end of the fissure is visible in the excellent photograph obtained by Mr. Loomis.

The other hot holes about Lassen Peak as far as I can learn have not increased their activity unless it is Bumpass Hell which is always fuming; but nothing like an eruption has been reported.

No definite molten products have been found in connection with the recent eruptions of Lassen Peak. The ejected dust as far as can be judged from an examination with a small pocket lens is disintegrated or pulverized da-

cite, perhaps in part decomposed. The quartz and apparently also the glassy feldspar are bright but the hornblende, augite and mica are of course not so abundant in the dacite and are less evident. An examination with a petrographic microscope confirms the conclusion that the dust is the product of the pulverizing action of the explosive gases on the rocks through which they are escaping, and not the result of the explosive expansion of gases in a liquid lava.

That heat has recently risen in the core of Lassen Peak is evident from the fact that whereas it was once cold now it is hot and steaming. When E. E. Hayden and I were on the mountain in July, 1883, and slid down the 2,000-foot snow bank into Hat Creek on our way to Yellow Butte there was no sign of heat in the summit of Lassen Peak. The rocky summit of the peak, struck by many thunderbolts during storms and superficially fused here and there by the lightning to fulgerite, is still as it was then and the little lake is there as in 1883; but the heat and the crater are new. Mr. Rushing tells me that these new features appeared with the first eruption. But the fact that the other hot places about the mountain are not yet perceptibly hotter indicates that the rise of temperature is local and does not at least as yet affect the mountain mass. Time alone can tell what Lassen is going to do. The volcano may subside to its former quiescence. But we must not forget that it was only the top of the old Vesuvius that was blown off to make Monte Somma and the Vesuvius of to-day. Krakatoa blew up from the very base with tremendous effect. There seems no good reason at present to fear a Krakatoan outbreak at Lassen Peak, but the part of wisdom dictates a close watch.

Eruptions, as a rule, break out suddenly. Sight-seers will generally find the viewpoint from which Loomis's photographs were taken close enough if the mountain is active, but if all is quiet and the seeker after knowledge must see the crater for himself he should be sure to ascend on the windward side, and approach with caution.

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM OSLER, regius professor of medicine in the University of Oxford, has been elected a foreign associate of the French Academy of Medicine.

MCMASTER UNIVERSITY, Toronto, has conferred the degree of doctor of laws on Mr. David Hooper, late economic botanist of the Botanical Survey of India.

THE honorary degree of doctor in engineering has been conferred by the Royal School of Mines, Freiberg, Saxony, on Edward Dyer Peters, Gordon McKay professor of metallurgy at Harvard University. The degree was conferred upon Professor Peters in recognition of his academic and practical services and writings on the metallurgy of copper.

SIR ST. CLAIR THOMSON has been elected an honorary fellow of the American Laryngological Association. There were only four living honorary fellows of the association—Professors Chiari, Massei, Moure and Sir Felix Semon.

THE Aeronautical Society of Great Britain has awarded its gold medal to Professor G. H. Bryan, of the University College of North Wales, for his work on aviation. The previous recipients of the gold medal of the society, which is the highest award of British scientific aeronautics, are Wilbur and Orville Wright (1909), and Octave Chanute (1910).

A CIVIL list pension of $600 has been granted Mrs. Annie Wallace, widow of Alfred Russel Wallace, in consideration of his eminent services to science and her inadequate means of support.

FROM the long list of honors conferred on King George's birthday on June 22, *Nature* selects the following as having done work for science: Sir Leonard Lyell, Bart., a nephew of Sir Charles Lyell, and formerly a professor of natural science in the University College of Wales, has been made a peer. Colonel S. G. Burrard, F.R.S., surveyor-general in India, has been appointed a K.C.S.I., and Mr. R. A. S. Redmayne, C.B., chief inspector of mines, has been promoted to the rank of K.C.B. The new knights include: Dr. J. G. Frazer, author

of "The Golden Bough"; Dr. W. P. Herringham, vice-chancellor of London University, physician to St. Bartholomew's Hospital; Dr. W. H. St. John Hope, archeologist; Dr. W. Milligan, known by his investigation into the connection of human and animal anthrax; Lieut.-Colonel Leonard Rogers, Indian Medical Service, professor of pathology, Medical College, and bacteriologist to the government, Calcutta; Dr. T. Kirke Rose, chemist and assayer to the Royal Mint; Dr. S. J. Sharkey, lecturer on medicine at St. Thomas's Hospital, and Mr. J. F. C. Snell, president-elect of the Institute of Electrical Engineers. The honor of knight bachelor has been conferred upon Dr. Douglas Mawson, the Antarctic explorer, and Professor T. P. Anderson Stuart, dean of the faculty of medicine at Sydney University. Mr. R. Meredith, director of telegraphs, India; Mr. A. Howard, imperial economic botanist at Pusa, Bengal; Major E. D. W. Greig, assistant director, Central Research Institute, Kasauli; Dr. T. Summers, late Bombay Public Works Department, and Mr. R. H. Tickell, chief engineer, Central Provinces, have received the honor of C.I.E. Dr. H. R. D. Spitta, bacteriologist to his Majesty's household, has been appointed M.V.O. (fourth class).

Dr. Erwin Baur, director of the Institut für Vererbungsforschung of the Königlichen Landwirtschaftlichen Hochschule in Berlin, has been appointed Carl Schurz memorial professor in the University of Wisconsin for the first semester of 1914–15. Dr. Baur will take up his residence in the university about the first of November, and will remain until the end of the semester.

Professor F. E. Austin, during the past six years head of the department of electrical engineering at Norwich University, has resigned to engage in engineering education extension work and the publication of several engineering books. During the present summer Professor Austin has charge of special classes in electrical engineering at the Thayer School of Engineering, Dartmouth College.

The disastrous fire at Salem, Mass., spared the Peabody Museum and the Essex Institute. The house of Dr. E. S. Morse, with its valuable papers, drawings, books and collections, also narrowly escaped.

Sir David Gill left the Royal Astronomical Society of London the sum of £250 to be employed by the council of the society in aid of astronomical research in grateful remembrance of the like sum paid out of the funds of the society in aid of his expedition to Ascension in 1876. He expressed the wish that the sum be devoted to some expenditure of a similar character, or to complete some work, such as the computation of new tables of the satellites of Jupiter.

Sir James Key Caird, of Dundee, has given $120,000 toward the expenses of the Shackleton Antarctic expedition.

M. Ole Olsen has offered to place at the disposal of M. Knud Rasmussen, the Arctic explorer, sufficient funds (about $75,000) for the fitting out of a North Pole expedition. The expedition, which will take provisions for two years, will be provided with all modern appliances and will be accompanied by staffs of scientists. The base will be at Cape York, in Greenland.

The Astronomical and Astrophysical Society will meet at Northwestern University, Evanston, Illinois, August 25–28.

An International Congress of School Hygiene will be held at Brussels in 1915, under the presidency of M. Corman, director-general of the ministry of public instruction, and Dr. Demoor, rector of the University of Brussels.

According to a resolution of the international executive committee chosen at the last congress in Paris, the Fifth International Congress of Genetics will be held in Berlin in 1916. The committee consists of representatives of the various German agricultural and horticultural societies. Wirkl. Geheim. Dr. Thiel is chairman. The congress will convene during the first week in September, 1916. The address of the subcommittee in charge of preliminary arrangements, Professors von Rümker

and Baur, is Berlin N. 4, Invalidenstr. 42, Kgl. Landwirtsch. Hochschule.

AT a meeting of the American College of Surgeons held in Philadelphia under the presidency of Dr. J. M. T. Finney, of Baltimore, on June 22, attended by eight hundred members, over $100,000 was subscribed toward an endowment fund for the establishment in Washington, D. C., of a permanent home for the institution. One thousand one hundred fellowships were conferred, bringing the total membership up to over three thousand.

THE advisory committee of the Tropical Diseases Research Fund (British Colonial Office) has granted £100 as a stipend for a helminthologist to conduct research work in the Quick Laboratory, University of Cambridge, and has contributed £300 with which to send Mr. E. Hindle, B.A., on an expedition to East Africa. Sir Dorabji J. Tata has contributed £250, and Mr. P. A. Molteno and Mrs. Molteno £400, towards the research work at the Quick Laboratory.

A COOPERATIVE fire agreement which has been entered into between the U. S. Department of Agriculture and the state of Michigan provides for an expenditure by the government of not to exceed $5,000 a year toward meeting the expenses of forest fire protection in Michigan. This form of cooperation between the government and the state is made possible by a law which congress passed in 1911, and which has already been taken advantage of by the states of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Maryland, West Virginia, Kentucky, Wisconsin, Minnesota, South Dakota, Montana, Idaho, Washington and Oregon. The law, besides providing for the purchase by the government of lands on the headwaters of navigable rivers for the purpose of creating national forests to protect these rivers, appropriated $200,000 which the secretary of agriculture might expend to protect similar lands in state or private ownership from fire, in cooperation with the states. It was provided in the law that the federal expenditures in any state should not exceed the amount spent by the state itself in the cooperative work. Provision for continuance of the work in the fiscal year which began July 1 has been made by an appropriation of $100,000 for the year. The original appropriation of $200,000 was available until expended, and with a supplementary $75,000 has carried the work to the present time.

THE most notable progress yet recorded in the chemical treatment of timber to prevent decay was made in 1913, according to a report recently issued by the American Wood Preservers' Association in cooperation with the forest service of the department of agriculture. The report states that 93 wood-preserving plants in 1913 consumed over 108 million gallons of creosote oil, 26 million pounds of dry zinc chloride, and nearly 4 million gallons of other liquid preservatives. With these the plants treated over 153 million cubic feet of timber, or about 23 per cent. more than in 1912. The output from additional plants unrecorded would increase the totals given. Impregnation of wood with oils and chemicals to increase its resistance to decay and insect attack, the report goes on to say, is an industry which has become important in the United States only in recent years. In Great Britain and most of the European countries practically every wooden cross-tie and telephone or telegraph pole receives preservative treatment. In the United States less than 30 per cent. of the 135 million cross-ties annually consumed are treated, and the proper treatment of an annual consumption of 4 million poles may be said to have scarcely commenced. Real progress in the United States dates from 1832, when the Kyanizing process, using bichlorides of mercury, was developed. In 1837 two other processes were introduced, the Burnett process using zinc chloride, and the Bethel process using coal tar creosote. These last processes are very largely in use to-day. The idea of timber preservation at first made very slow growth in this country, on account of the large supply of cheap and durable timbers and the general disregard shown toward economy in the use of natural resources. In 1885 there were only three pressure plants

in the United States; and in 1895 only 15. Since then, however, the industry has grown rapidly; in 1913 there were 117 plants.

Professor Charles E. Porter, occupying the chair of general zoology and applied entomology and director of the recently established museum and laboratory of economic zoology at the National Agricultural Institute of Santiago, Chili, has undertaken the publication of a new scientific journal under the title "Anales de Zoologia Aplicada." This journal is to be especially devoted to original studies on species beneficial to and parasitic on man, domesticated animals and cultivated plants in America. The "Revista Chilena de Historia Natural," edited by Professor Porter, is being continued, but only for systematic papers. The "Anales de Zoologia Aplicada" will be published quarterly, illustrated with text figures and when necessary with plain or colored plates. It will accept original contributions on American parasites.

"Art and Archeology" is the title of a new non-technical illustrated magazine published by the Archeological Institute of America, the first number of which bears the date of July, 1914. During the present year four numbers will be issued, but commencing with 1915 the magazine will appear monthly. Its fifty pages are devoted to articles covering a considerable range, and to minor notes and brief book reviews. The editorial staff consists of: General Editor, David Moore Robinson, Johns Hopkins University; Advisory Editor, Allan Marquand, Princeton University; Art Editor, William H. Holmes, Smithsonian Institution; Associate Editor, Ralph Van Deman Magoffin, Johns Hopkins University; Contributing Editors, H. Rushton Fairclough, Stanford University, Charles H. Weller, University of Iowa, Albert T. Clay, Yale University, Frederick W. Hodge, Smithsonian Institution, Charles T. Currelly, Royal Ontario Museum, George H. Edgell, Harvard University; Managing Editor, Mitchell Carroll, General Secretary, Archeological Institute of America, The Octagon, Washington, D. C.

A group representing a number of deep-sea luminous fishes has been completed in the American Museum of Natural History and opened to the public. It represents ten species of fishes found in the depths of the sea, half a mile or more from the surface. Some of the fishes are provided with rows of luminous organs or with headlights, while others have a light at the end of a tentacle with which to attract their prey. The group is illuminated by electricity in such a way that the fishes may be viewed first as synoptic specimens in a case and secondly, as if they were living fishes swimming in the darkness of the deep sea, lighted by their own luminous or phosphorescent organs.

A little more than 33,000 acres in the White Mountains have been approved for purchase by the government at a meeting of the national forest reservation commission. These areas are in two separate tracts, both in Grafton county, New Hampshire, the larger containing 31,100 acres on the watershed of the Pemigewasset River, a tributary to the Merrimac. The tract comes within a mile of North Woodstock on the Boston and Maine railroad, and several good roads lead through it. The land is between 700 and 4,300 feet in elevation, and in the lower valleys are a number of abandoned farms now grown up to trees. Most of the conifers have been cut to make paper pulp, but there are good stands of beech, birch and maple of considerable value. With fire kept out there is said to be excellent promise of a new stand of spruce. The price agreed upon by the government is $4.62 an acre including both land and timber. The smaller purchase consists of several areas lying on the watersheds of Little River and Gale River, both tributaries of the Connecticut. These lands cover 2,000 acres and are contiguous to lands already approved for purchase; hence they go far toward giving the government a solid body of land in this locality. The price for the 2,000 acres, land and timber, is $4.00 an acre. The tract is in the locality of the noted Franconia Range and is readily accessible from two railroad stations, Bethlehem and Twin Mountain. The forest has been cut over and consists chiefly of the northern hardwoods, though some spruce remains from the

original stand. At the same time that these White Mountain areas were approved, the commission also approved the purchase of the Pisgah Forest in North Carolina, from the George W. Vanderbilt estate. These tracts bring the total eastern forests up to 1,077,000 acres.

THE production of anthracite coal again broke the record in 1913, exceeding the highest previous output by nearly 1,000,000 tons, according to figures compiled by E. W. Parker, coal statistician of the United States Geological Survey. Including the coal recovered from old culm banks and a small quantity dredged from Susquehanna River, the production of anthracite for the year was 81,718,680 long tons, valued at $195,181,127, compared with 75,322,855 tons valued at $177,622,626 for 1912. This is an increase of over 6,000,000 tons in quantity and more than $17,500,000 in value. The previous highest record was 80,771,488 long tons, in 1910. Anthracite miners and operators are now working under an agreement extending over a period of four years from April 1, 1912; there were consequently no serious interruptions to mining operations by labor troubles in 1913 and industrial peace is assured in the anthracite region until 1916. As the use of anthracite coal as a manufacturing fuel has been practically eliminated, its production is not affected by trade conditions to the same extent as that of bituminous coal. The increase in the use of artificial gas and of coke for domestic purposes will, in Mr. Parker's estimation, probably keep pace with the increase of population in the markets supplied by anthracite, and there is little probability that anthracite production will show any marked increase in the future. Another record in addition to that of tonnage was established in the anthracite region in 1913. The average working time for men, 257 days, exceeded anything in the history of the industry, the nearest approach being in 1911, when an average of 246 working days was recorded. In 1912 the average was 231 working days. The average number of men employed in 1913 was 175,745. Reports to the Bureau of Mines show that there were 618 fatal accidents.

UNIVERSITY AND EDUCATIONAL NEWS

THE East London College (University of London) has received from the Drapers' Company about $75,000 to defray the cost of the erection and equipment of the new chemical laboratories of the college.

DR. HERBERT STANLEY BIRKETT, a specialist in diseases of the nose, throat and ear, has been appointed dean of the medical school of McGill University.

AT Vassar College the following appointments have been made: Aaron L. Treadwell, title changed from professor of biology to professor of zoology; Cora J. Beckwith, Ph.D. (Columbia, '14), promoted from instructor to assistant professor of zoology; Emmeline Moore, Ph.D. (Cornell, '14), instructor in botany, vice Assistant Professor W. J. Robinson, who becomes dean of the Women's Affiliated Colleges of Delaware; Elizabeth Cutter (Vassar, '11), Hazel Schmall (Colorado, '13), and Celia Jordan (Vassar, '14), have been appointed assistants in biology.

DR. H. E. EWING, Ph.D. (Cornell, '11), and Assistant Professor V. I. Safro, B.S.A. and postgraduate (Cornell, '09), have resigned from the Oregon Agricultural College, department of entomology. The present organization of the department is as follows: H. F. Wilson, M.S. (Oregon Agr. Col., '13), entomologist; A. L. Lovett, B.S. (Okla. Agr. Col., '10) and G. F. Moznette, B.S. (Oregon Agr. Col., '14), assistant entomologists.

DR. F. R. MILLER, of the department of physiology, McGill University, has been appointed professor of physiology in the Western University, London, Canada.

MR. IELSON C. DALE, of the graduate college of Princeton University, has been appointed associate professor of geology at Hamilton College.

FOLLOWING the retirement of Professor J. M. Thomson, Professor H. Jackson has been appointed head of the chemical department at King's College, with the title of Daniel professor of chemistry in the University of London.

Professor A. W. Crossley has been appointed to a university chair of chemistry, tenable at King's College.

DISCUSSION AND CORRESPONDENCE

THE CONFERRING OF THE BACHELOR'S DEGREE UPON NON-GRADUATES

The question of giving degrees to non-graduates who for various reasons have failed to obtain them while resident students is one that faculties of colleges and technical schools are frequently called upon to decide. Every year students leave college because of illness, financial embarrassment, lack of interest, defective scholarship and sometimes misconduct.

Some of them enter other institutions or subsequently return to their own college, and, after fulfilling all requirements, receive their degrees. Others enter business or professions in which they become so occupied that they find it impossible to take the time necessary for the completion of their collegiate residence and training.

Such men often attain distinction in their professions or prominence in other ways, and apply for degrees, being urged thereto by some admiring former classmate, or at the solicitation of some member of the faculty, who is enthusiastically appreciative of their continued interest, financial or otherwise, in the college. It is not easy to understand why one who has attained distinction in his profession should seek an undergraduate degree when such degree signifies nothing beyond the fact that the possessor, prior to his entering his profession, has completed a prescribed course of study in preparation therefor.

The applying for and the granting of a degree on any other basis than its being earned puts an abnormal importance on the degree itself and stamps the recipient with a misleading trade-mark.

Investigation shows a wide variation in this practise among prominent universities, colleges and technical schools. Some grant no degrees except for the completion of a prescribed course in residence; others accept a certificate for the performance at another institution of such part of the work or its equivalent as the candidate may lack; and then there are some which grant degrees on a minimum residence of two years with "fair" standing, honorable dismissal and a "creditable" record varying from ten to twenty-five years subsequent to leaving college.

During the past two years this question of granting degrees to non-graduates has been repeatedly brought to the attention of the faculty of the Worcester Polytechnic Institute and a committee was appointed to investigate the matter. In order to ascertain the practise in other institutions a circular letter asking for information was sent to all universities, colleges and technical schools on the accredited list of the Carnegie Foundation. Also a letter was sent to most of the graduates of the Worcester Polytechnic Institute who have been or are now engaged in teaching, to ascertain their views on the question. This committee after careful consideration of all the information which had been assembled brought in a report which was unanimously adopted by the faculty. Since a number of institutions with which the committee corresponded expressed the desire to be informed as to the conclusions reached, it has seemed best to publish the whole report.

REPORT SUBMITTED TO THE FACULTY OF THE WORCESTER POLYTECHNIC INSTITUTE

The committee to which was referred the question of providing some means whereby degrees may be conferred upon non-graduate students submits the following report:

1st. That the committee recommend that the degree of Bachelor of Science be conferred only on those who have completed one of the courses of study prescribed at this institute as leading to that degree.

2d. That in the opinion of the committee it is not wise to grant any honorary degree to a non-graduate; but in the opinion of the committee the names of all former students should be printed in some official publication of the institute.

The general reasons which have influenced the

committee in making the recommendations are as follows:

1. We have great respect for those who have left the institute without completing a course and have nevertheless been successful in their profession; but we do not believe that, in general, such men feel the need of a degree or wish the institute to lower its present high standing among engineering schools by granting unearned degrees.

Replies to inquiries sent to all of our graduates, who are engaged in educational work and who are in a position to feel the responsibilities and appreciate the importance of maintaining collegiate standards, show that there is no general demand on the part of graduates that such degrees should be granted and that many graduates are strongly opposed to the plan.

2. A Bachelor's degree as granted by an engineering school is essentially a certificate that the recipient has completed a course of study in preparation for the practise of engineering. Such a certificate can not honestly and honorably be granted to one who has not completed the work specified as necessary.

3. It does not seem possible to devise any method of granting the Bachelor's degree to one who has not completed a specified course of study, without lowering the value of the degree for the regular student and for those who have fully earned the degree.

4. If the definite requirement of a completed course of study were once abandoned there would be no definite halting point in the process of reducing the arbitrary and fluctuating requirements that might from time to time be substituted. The result would probably be an undignified struggle to modify the requirements so as to meet exceptional cases and in the process we should be likely to cause as much disappointment as satisfaction among our non-graduates.

5. We have received information from 60 of the prominent universities, colleges and technical schools as regards their practise in the matter. Of these, 44 do not confer the Bachelor degree on any one who has failed to complete a prescribed course; 14 grant degrees with more or less regularity on the basis of subsequent merit, one has granted two such degrees and one has granted degrees in two instances for a large amount of subsequent research.

A study of the replies leads us to believe that in general the institutions which grant unearned Bachelor's degrees find the system a source of difficulty and dissatisfaction and some of the replies are decidedly apologetic and defensive.

We believe the existence of such a system is a discredit to higher education in general and that the movement is away from it. One leading university has already abandoned it after long trial, and another is endeavoring to get rid of it. We think that it would be a serious mistake for the institute at the present time to adopt what we regard as a discredited and discreditable practise.

W. L. JENNINGS

MULTIPLE FACTORS VS. "GOLDEN MEAN" IN SIZE INHERITANCE

GROTH'S preliminary note on the "golden mean" in the inheritance of sizes in SCIENCE of April 17, 1914, pp. 581–584, deserves the attention of geneticists. Its publication is of such recent date that I need only call attention to one or two points that seem to me of particular moment.

In brief, Groth's hypothesis is that the mode of inheritance in F_1 not only of surfaces and volumes, but also of linear dimensions is to be expressed by $\sqrt{ab}$ rather than by $a+b/2$ where a and b are parent sizes. The hypothesis is based upon measurements of a large number of tomato fruits of parental and F_1 plants. It will certainly be worth determining whether Groth's expression fits size characters in other plants. A hurried examination of data, both published and unpublished, derived from my own studies of seed size in beans and maize, indicates that F_1 sizes are nearer the average than the geometric mean of the parent sizes. But my object now is not to lay stress upon any possible agreement or disagreement between my results and those of Groth. It is rather with the relation of Groth's hypothesis to the idea of multiple factors that I am here concerned.

That Groth's hypothesis is essentially Mendelian is shown by the fact that his size factors are assumed to segregate in equal numbers in the gametes of F_1 plants. That he regards his hypothesis as entirely unlike

the multiple factor hypothesis is indicated clearly by these statements:

> We know that size characters do segregate in the F_2, but we admit that with them the simple Mendelian ratio of 1:2:1 is never realized, though in large populations the parental sizes may reappear. Mendelians commonly try to account for the complicated ratios by assuming the presence of multiple factors; non-Mendelians point to the same ratios as quasi-evidence against Mendelian inheritance. I offer a different explanation.

By way of conclusion, Groth further remarks:

> The finding in the F_2 or later generations of lines which breed true to size characters is thus not proof of the presence of multiple size factors in the original parents.

It is evident, however, notwithstanding Groth's disavowal, that his hypothesis is distinctly a multiple factor one. His suggestions as to how spherical fruited parent races, the dimensions of whose fruits are $4 \times 4 \times 4$ and $9 \times 9 \times 9$ respectively, might combine to produce F_1 fruits of dimensions $6 \times 6 \times 6$ is rightly regarded as having a bearing "beyond furnishing an explanation of partial dominance in F_1." It might seem at first that he regards volumes as the inherited units and that volume, together with a shape factor, controls linear dimensions. This is evidently not, however, his idea. In the cross noted above for illustration, a gamete bearing a length factor 9, a breadth factor 9 and a thickness factor 9 differs from a gamete bearing a length factor 9, a breadth factor 4, and a thickness factor 9 or 4 with respect to its effect not only upon the volume of the resulting fruits but also upon the length of those fruits. The postulated spherical shape factor, which is common to all gametes, but which modifies the common length factor 9 only in case the breadth or thickness factors are other than 9 and does not modify it in case these breadth and thickness factors are 9, is certainly somewhat confusing. But to say that a length factor 9 produces an effect equal to 9 in length when the breadth and thickness factors are also 9 and produces some other effect on length when the breadth and thickness factors are other than 9 is merely the equivalent of saying that the breadth and the thickness factors have an effect upon length and are thereby length factors. This makes three factors for length—a typical multiple-factor hypothesis.

Again, if the presence of the somewhat fanciful shape factor be insisted upon, we are still dealing with multiple factors. In his illustration, Groth assumes two length factors, 4 and 9 and a shape factor that modifies them under certain conditions. This makes three factors affecting length. We can not limit the length factors to the two, 4 and 9, and say that the third factor assumed to modify length is nevertheless not a real length factor merely because we have chosen to call it a shape factor. Genetic factors for any character are the inherited units that have an effect upon the development of that character. The fact that some of them may also be concerned in the development of other characters, while really important, is immaterial in this connection.

It was said above that a shape factor affecting length, plus the two length factors 4 and 9, make a complex of three multiple factors for length. As a matter of fact there are more than three such factors, if we hold to the shape factor. The shape factor was shown to modify length only in certain cases, namely, when the breadth or the thickness factor is not of the same value as the length factor. In other words, the ability of a shape factor to modify length is influenced by the presence of breadth and thickness factors and the latter thereby become at least indirect length factors. But who, in the present state of our knowledge, can say that the assumed primary length factors 4 and 9 are less indirect in their effect than are the other factors influencing length?

I do not wish to appear too critical of Groth's suggestions. It is only by a careful analysis of such novel suggestions that we can hope to gain a better understanding of how genetic factors behave. My purpose is merely to aid in such an analysis.

R. A. Emerson

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THE GOLDEN MEAN

TO THE EDITOR OF SCIENCE: With reference to the article on the "Golden Mean" in your issue of April 17, may I recall the fact that in a letter which appeared in Vol. XXXII., p. 625, I showed that the mean of the F_1 offspring of two families crossed at random is, on certain assumptions, the geometric mean of the parental averages. I confess that I can not bring Mr. Groth's results for crossing individual plants into line with the theory propounded in my letters, but, at any rate, it is suggestive that a theoretical reason for the appearance of geometric means in connection with inheritance can be given.

A. B. BRUCE

LONDON,
May 5, 1914

DISAGREEMENTS IN CHEMICAL NOMENCLATURE

THE number of SCIENCE for January 23 contains an article by Dr. F. W. Clarke which undoubtedly strikes a sympathetic chord in the majority of American chemists. That any chemical element should be given different names by two groups of chemists is indeed lamentable, the more so that each of these groups contains many scientists of enviable reputation who naturally would be expected to place themselves far above the petty jealousies which characterize many societies of less learned persons.

That a scientist who contributes to the known knowledge of chemistry to the extent of discovering a new element should not be granted the privilege of naming that element is anything but just. The columbium-niobium controversy is an excellent example. The discoverer of the element named it columbium; others later took it upon themselves to rechristen the element. The columbium-niobium controversy is not in the least a question of which is the better name—it is a question of bestowing any honor incident to the discovery upon the one to whom it belongs.

But this is merely one of several cases of disagreement in names. In 1798 the French chemist Vauquelin discovered a new element while working with the mineral beryl. Unfortunately Vauquelin did not suggest a name for this new element but he did note that the oxide is characterized by a sweetish taste. On account of this property the editors of the *Annales de Chimie,* the journal in which Vauquelin described his discovery, at once suggested the name glucina for the new earth. The name was immediately adopted by the French. Later the German chemists adopted the name beryllium which they have retained ever since. At the present time the German and Spanish chemists use the name beryllium while the original name glucinum, given by the French, is used by the French, Russian and Italian chemists. Among English chemists as well as those of America, both names are in rather common use. In glancing through twelve chemical text-books in English, all supposedly of college caliber, the author finds that seven make use of the name glucinum whereas only three give preference to the name beryllium. One apparently gives no preference and one does not mention the element except in the table of international atomic weights in which it appears as glucinum. In the publications of the United States Geological Survey the name glucinum is used.

The index of the *Journal of the American Chemical Society* for the year 1904 contains references to articles on beryllium but none on glucinum. For the year 1905 the index likewise contains references under the name of beryllium only, notwithstanding that one of the articles referred to is a note on the atomic weight of glucinum and does not mention the other name. The index for 1906 contains three beryllium references and one glucinum, while those for the years 1908 and 1909 contain beryllium only. In the *Abstract Journal,* four beryllium articles and one glucinum are indexed for the first year, 1907, while the index for 1908 contains references to several beryllium articles and also to several on glucinum. In the volumes of the *Abstract Journal* which have been issued since 1908, the name beryllium alone is used regardless of the name which appeared in the various articles abstracted.

The element tungsten is the subject of a still more exaggerated disagreement. Scheele was unquestionably the first to mention this element, stating that he had found, in the mineral then known as tungsten but now called scheelite, a new acid to which he gave the name tungstic acid. Two years later, in 1783, it was noted by three Spanish chemists, the d'Elhujar brothers, that the new acid is also present in the mineral wolframite. The German name wolfram was derived from the name of this mineral. At the present time the element is known as wolfram by the Russian and German chemists while the English, French, Spanish and American chemists employ the name tungsten. It is interesting to note that the English and American chemists, although clinging to the historically more correct name, unanimously use the symbol W for this element. On the other hand, the French not only employ the name tungsten but represent it by the symbol Tu.

Still another interesting example. Rutherford and Priestley in 1772 independently demonstrated that after a time an enclosed volume of air no longer supports combustion or respiration. Lavoisier, however, was the first to recognize that this residual air, after removal of the carbon dioxide, is a simple body. On account of its inability to support life, he immediately named the gas azote, deriving the name from a Greek expression meaning literally antagonistic to life. The name nitrogen which the element now commonly bears was first suggested by Chaptal. At the present time the chemists of France and Russia still cling to the original name azote with the symbol Az, while to the chemists of most other nations the element is nitrogen. Nevertheless we still have in English a few relics of the original name, as for example, the names hydrazoic acid, hydrazine, azine and azole.

The adoption or use of a name other than the one originally given to an element by its rightful discoverer is by no means an indication that the discovery is discredited. Although the German chemists unanimously employ the name wolfram, they nevertheless do not hesitate to attribute the discovery to Scheele. Again, these same chemists invariably concede Hatchett to be the discoverer of columbium, although they have substituted and use the name niobium erroneously given to the element by Rose some forty years later. In all probability the greatest argument which the chemists of certain nations can offer to-day for endorsing the name niobium is the common use which that name has had in their respective countries since the days of Heinrich Rose.

It is unfortunate indeed that there should be lack of unity amongst scientists as to the names and symbols for such fundamental bodies as the chemical elements, but it is still more unfortunate that the chemists of any one land should be divided in their selection of a name for an element as we Americans are with respect to glucinum. A solution of the entire question of names and symbols could be brought about by the appointment of an international committee definitely instructed to waive all petty jealousy and, in a spirit of all fairness, diligently to search the literature, consider all claims of priority and finally report on the original and therefore most proper name for each element. That the chemists of various nations would agree to the appointment of a committee so instructed is entirely possible but very improbable. Furthermore, it is extremely doubtful if a report submitted by such a committee would be adopted by more than one third of the chemists of chemical societies to-day. It would, however, be a comparatively simple matter for American chemists to intrust the settlement of this question to a carefully chosen committee in order that we Americans might use uniform names and symbols although unable to agree entirely with the chemists of other nations.

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The Professor and the Institution

In America, we have in name freedom of speech; in fact there are considerable areas of

matters vital to human welfare discussion of which is socially and publicly taboo. We have in name freedom of the press; in fact journalistic intelligence is narrowed in its expression by public indifference and muzzled by the private interests of private owners. I suppose that the artist's right to express his own soul is theoretically conceded; but I am confident that any artist who should attempt Gallic liberties in his self-portrayals would but placard his name to distrust and put his genius in perpetual quarantine. The case of the teacher who happens to be also a thinker is better than these chiefly from the circumstance that his right to express his thought is a more present issue and is likelier to come to an early solution.

The issue of "academic freedom" is the problem of adapting institutionalism to personalities. Education has become an involved affair, with elaborate "plants," ornate administrations, and a distinguished sense of what the eloquent speech of Manhattan would call its "front." Few, I imagine, doubt the utility of these perquisites; while none conceding this can question the importance of the institution or the high sufficiency of its administrative avatars. And yet if the institution of education becomes too gross of organization, it loses the end of education. Perfunction is the oil that smooths administration, but it clogs and dams personality; and education apart from personalities, in place of a Socratic mid-wifery to souls, becomes the deft art of spiritual undertakers—the school is replaced by the morgue. Our danger is obviously lest the instrument kill the growth it was designed to foster.

Putting the matter concretely, education, as it is nowadays conceived, has two requirements different to the point of antagonism. On the one hand there is the need for elaborate material and financial equipment, and with it all the accompanying interplay of institution and public. This is a problem of ingenious government and politic administration, demanding for its success an essential solidarity. On the other hand, if the function of the institution is to be fulfilled, the right of the teacher to think and to speak his thought must be subject only to his own wisdom—at least within the province of his subject; and this spells essential individuality. Thus we are presented to a dilemma, with horns equally brazen.

Doubtless the ideal solution would be the creation of a breed of teachers gifted with a military scorn of danger and a high indifference to economic death. There is, as the matter stands, a lingering suggestion of effeminacy about the professorial craft. Men generally suspect in the professor a deficient virility, and they look upon scholarship as a kind of spiritual cosmetic designed to conceal an enfeebled soul. It might habilitate the teacher's profession in the general eye, and perhaps enhance the teacher's own esteem of it, if the business were made perilous and publicly spiced with rash braveries of expression. But the difficulty of this heroic road is that only the tame would be left to teach. Eventually—and in no long eventuality—it would destroy the schools.

What is needed is clearly a compromise (and let not the term be regarded as a sign of fear; all practicalities are compromises, and language, the most practical of all is the most compromising of all, for every word is a compromise of its meanings). The institution, in its essential solidarity, is necessary to the professor; the professor, in his essential individuality, is necessary to the institution. This mutual necessity must surely yet mother a thrifty progeny.

Every one interested in the situation has, I suppose, his scheme of melioration. I have mine. Let me briefly sketch it. I am speaking, be it understood, of colleges and universities.

Suppose that in each institution there were a clear legal distinction between the professoriate and the administrative body. In the hands of the latter should rest all problems of organization, publicity, expansion or contraction of curricula, material control, and all appointments except to the professoriate; it

should have in its hands the essential conduct of the institution, as at present. Only one power which it now has it should not have: the direct power of appointing or of removing a "professor." For the professoriate should be composed just of the men bearing the title "professor," whose rights should be: (1) Appointment only on election by the professoriate, according to its own rules of election. (2) Removal only after trial by the professoriate, according to its own rules. (3) Assurance of a certain minimum salary—determined by the custom of the institution—so long as the title of "professor" remain unrecalled; and (4) assurance of the right to teach the subject defined by his complete title, during the like period.

Under such a division any administration could impeach any professor, demanding his trial by the professoriate, but it could not remove him until this trial had resulted in the revocation of his title. On the other hand, no professor would be allowed administrative control of any department or school except on appointment to such work by the administration. Further, there should be allowed various titles, such as "assistant" or "associate professor," to be given by the administration to men to whom it wished to encharge work newly introduced as well as by the younger men who might be regarded as candidates for the rank and position of "professor." These men, in each institution, would be serving a probation, preliminary to their final election to the body of the professoriate. There should be nothing to prevent the administration from paying such men even higher salaries than the professorial minimum, and indeed nothing to prevent any advance in salary to a "professor" above this minimum. Of course any "professor" should be eligible to any administrative office without sacrificing his professorial rank and rights.

This scheme, viewed *a priori*, ought to be easy to introduce and maintain. A charter body of professors should be selected from the staff already in service by the administration of each university and college, and contractually endowed with the rights named. Presumably, the body so selected would represent the present sentiment and ideals of the institution, while the natural conservatism of a self-perpetuating body would ensure a reasonable constancy in its character. Young men would be tried out before being elected to the body; while the administration would retain ample power to guide the general development of the institution.

Our present plan, in which the head of the institution is, internally to it, the benevolent autocrat, and, externally to it, the responsible politician, is an ugly makeshift. The plan here proposed ought to lighten the cares of such a head by lessening his responsibilities, while at the same time it would relieve the professorial profession of the stigma of servility, and it would give the supporting public a less flickering consciousness of the fact that in calling a man to the thankless task of thinking they are incurring obligations as well as receiving benefits.

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SCIENTIFIC BOOKS

The Antiquity of Man in Europe, being the Munro Lectures, 1913. By James Geikie, LL.D., F.R.S. Pp. xx + 328, 9 text illust., xxi pl. and 4 maps.

This is a series of lectures upon a subject with which Professor Geikie's name has been associated for more than a third of a century. His "Prehistoric Europe" appeared in 1881 and the matter received more than incidental consideration in the third edition of his "Great Ice Age." The work is an argument from the geologist's standpoint, the most important of all, since geology is the final court of appeal.

The subject is outlined in the first lecture. The general features of Pleistocene climate and its extreme variations are shown in a discussion of the several faunas and floras, which affords opportunity for comparison with present conditions in Asia and North America. He is led to believe that, while there is ample proof that man existed early in the Pleistocene, there is thus far no positive evidence of his

existence during the Tertiary. Having outlined his plan, he examines the kinds of evidence. Two lectures are devoted to the testimony of caves, in which the investigations are summed up with critical notes upon the reported observations. He indicates clearly the gaps in the record, but he emphasizes the association of paleolithic man with an extinct fauna and flora, the definite proof of successive extreme variations in the continental climate, the differing types of men during the several stages and their notable gradation in civilization as proving the great length of time which has elapsed since the first cave man appeared in Europe. The testimony of river drift deposits, especially those of Great Britain and France, is the topic of another lecture. The complex problem involves the deepening of valleys by river-cutting, the deposition of gravels, the origin of loess. The difficulties here are conceded frankly, but the deficiencies in this record do not coincide with those in that of the caves; the two records are supplementary.

The testimony of glaciers, as one would expect, is discussed in abundant detail. In this portion, composing nearly one half of the volume, the wholly new material derived from the author's later studies in many regions is very great. The movements of glaciers, their scouring and eroding power, their extent, the nature and distribution of moraines, the truncated valleys of the Alps are discussed in the light of recent determinations by the author and others. All go to show the immensity of the period during which man has been on this globe. The comprehensive study of local and general features, which is presented in these four lectures, contains much that can not fail to interest American glacialists, for some of the phenomena cited from Great Britain and the Continent are familiar topics in our literature.

Having laid his foundation, the author, in his closing lectures, sums up Pleistocene history as relating to man. The terms for the epochs differ in several cases from those given in the Great Ice Age, some changes having been made in the interest of accuracy and euphony. The epochs as defined in this volume are these:

First Glacial epoch, the Scanian of northern Europe, the Günzian of the Alps; First Interglacial epoch, the Norfolkian; Second Glacial epoch, Saxonian of northern Europe, Mundelian of the Alps; Second Interglacial epoch, the Tyrolian (replacing Helvetian); Third Glacial epoch, Polonian (replacing Polandian) of northern Europe, Rissian of the Alps; Third Interglacial epoch, the Dürntenian (replacing Neudeckian); Fourth Glacial epoch, Mecklenburgian of northern Europe, Wurmian of the Alps; Fourth Interglacial epoch, the Lower Forestian; Fifth Glacial epoch, the Lower Turbarian; Fifth Interglacial epoch, the Upper Forestian; Sixth Glacial epoch, the Upper Turbarian.

The oldest human remains are assigned to the first interglacial epoch; the Chellean and Acheulian stages to second; the Mousterian stage began during the third glacial and ended during the third interglacial; while the Aurignacian, the Solutréan and Magdalenian stages were within the fourth glacial. Paleolithic man's disappearance was abrupt and with him the associated fauna passed away. Neolithic man's appearance seemed to be equally abrupt and the modern fauna accompanied him. A partial bridge over the gap is afforded by the Azilian stage of southern France and Germany, which belongs very near the Lower Forestian or fourth interglacial epoch; at that time, Neolithic man was in Scotland.

Professor Geikie's work does not lend itself readily to review for it is a model of directness and compactness in statement. The discussion is judicial; facts are presented so skillfully that they appear to form a consistent argument and when the conclusions are reached, they have been anticipated by the reader as the only ones possible. Among glacialists there are those who will continue to dissent from the author's subdivision of the Pleistocene and from the extreme length of time which he assigns to that period; but all must agree with his final statement that when one considers that man has seen all those changes of climate, which caused repeated succession

of steppes, tundras and forests in the same region, he must recognize that the time has been very long—so long, that the few thousands of years since history began seem insignificant in comparison.

John J. Stevenson

The Psychology of Management. By L. M. Gilbert, M.L., New York, Sturgis and Walton. 1914. Pp. 344. $2.00 net.

The gap between psychology and industry is being bridged both by psychologists, who write of industry, and by industrial engineers, who attempt to point out the psychological laws underlying the success of their practise. This book is of special interest since it is written by a woman worker in an industrial laboratory where the give and take of psychology and technology is being encouraged in many interesting ways.

The book aims "not so much to instruct as to arouse an interest in its subject and to point the way whence instruction comes." In the mind of the reviewer, these aims are fully realized. The main theme is that modern form of management generally known as the "Taylor system." In this book the art of management attempts to become conscious and to develop or borrow a vocabulary. Management is defined as "the art of directing activity," and by the psychology of management is meant "the effect of the mind that is directing work upon that work which is directed, and the effect of undirected and directed work upon the mind of the worker." Such topics as the following indicate the general scope of the various chapters: selection of individual workers; proper instructions; functionalization of tasks; definition of duties and qualifications; motion studies and time measurements; analysis and standardization of task, tools, methods and materials; records, routing and work programs; the rôle of the various types of direct and indirect incentives (punishment, reward, prizes, bonus, profit sharing, etc.); welfare work; attitudes of employer and employee and their effect on work; methods and measurement of teaching; aids in learning; effective distribution of effort. Cooperation is urged in the accumulation of standardized industrial records for the purposes of psychological analysis.

As might be expected, the psychology of management, in its present state, shows several traits similar to those displayed by the science of education in its earlier days. In the present book, for instance, there is artificial systematization and an occasional lapse into discursive generality. There is a somewhat labored attempt to suggest forward movement in the thought by means of divisions and paragraph headings in the text; many paragraphs consist of a single sentence. There is an apparent attempt to give text-book form to a subject that is not yet ready for it.

In spite of these remediable features the book is a real contribution to applied psychology as well as to the work of the student of efficiency engineering. It well typifies the growing tendencies toward cooperation between science and practise and suggests a stimulating program for future work. Applied psychologists should not fail to make themselves acquainted with the Gilbreth laboratory.

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Monographien einheimischer Tiere. Bd. 5, Die Strudelwürmer (Turbellaria). Von Privatdozent Dr. P. Steinmann und Professor Dr. E. Bresslau. Pp. xi + 380, 2 pls., 156 figs. in text. Bd. 6, Tintenfische mit besonderer Berücksichtigung von *Sepia und Octopus.* Von Dr. Werner Th. Meyer. Pp. 148, 1 pl., 81 figs. in text (Klinkhardt, Leipzig).

The latest numbers in the admirable series of monographs prepared under the editorship of Professors H. E. Ziegler, of Stuttgart, and R. Woltereck, of Leipzig, both deal with animals widely used in experimental or in morphological work in the biological laboratories of our universities and colleges, and both are particularly welcome. The volume dealing with the turbellarians is doubly welcome, since no brief and comprehensive treatise has dealt with these easily obtained and widely utilized animals since Benham's (1901) short account in Lankester's "Treatise on Zoology." More-

over, we find in the volume in hand fuller treatment of four aspects omitted in Benham's, namely the ecological, the physiological, the experimental and the systematic, and these are as adequately done as are the morphological and embryological phases, indicative of the breadth and catholicity of current German biological scholarship. Under the head of "Biologie," for example, we find a discussion of such topics, among others, as locomotion, nutrition, food-taking, commensalism, parasitism, hunger, excretion, sexual and asexual reproduction, autotomy, regeneration in different species, influence of external factors in accelerating and inhibiting regeneration, form regulation, heteromorphosis, duplication, natural malformation, sensory reactions, foes and parasites. Both triclads and rhabdocœls are very fully treated. An abundance of simple diagrams truly illustrate the text, and a key to species, a glossary, and a bibliography complete it.

The work is exceptionally comprehensive in scope, though brief, and well-proportioned, as well as admirably conceived and worked out. If any criticism is to be passed upon it one might suggest that the illustrations are below the standard to be expected in German books, and that the experimental work of Morgan and his school, and the mine of information in Pearl's monographic treatise on the behavior of Planaria have been wholly overlooked, in fact, the sources as well as the "Tiere" appear to have been "Einheimischer."

The information pertaining to the Cephalopod type has been much more accessible, thanks to Brook's chapter in his "Invertebrate Zoology," to Bauer's admirable "Einführung" (1909) in the Naples "Mitteilungen" prepared especially for the assistance of experimentalists deficient in zoological training, to Isgroves (1909) monograph on *Eledone* and Williams (1909) on *Loligo*. Dr. Meyer's booklet is supplementary to these in that it deals with *Sepia* and *Octopus*, forms equally desirable as laboratory types. The work is very largely anatomical, a departure from the general scheme of the series, justifiable perhaps in view of Bauer's paper and of the fact that the devil-fish is never seen in living condition by the biological student outside of the seaside laboratory with ample aquaria, for cephalopods do not long withstand removal from the normal habitat. One expects a fuller morphological treatment of the kidney, the eye, the hectocotylus, the chromatophores and the phosphorescent organs, than he finds here, and in fact the whole treatise might have been elaborated in greater detail on both genera to the advantage of the reader. The discussion is direct, lucid and well-adapted to serve the purpose of an elementary introduction to cephalopod morphology.

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The Copper Handbook. By WALTER HARVEY WEED. Published by the author; Houghton, Michigan, 1914. Vol. XI., 1912–13. Pp. 1413. Price $5.00.

The "Copper Handbook," well-known to all those interested in copper mining, has been taken over by Mr. W. H. Weed, who has issued a new revised edition bearing the date of 1914. Since its establishment by H. J. Stevens in 1900 this useful compendium of information about the copper mines of the world has gone through ten previous editions. The reliable information and fearless criticism contained in it were greatly appreciated by mining men. Since the unexpected death of its founder in 1912 the work of preparing a much needed new edition has been undertaken by W. H. Weed, the well-known geologist and mining engineer, formerly connected with the U. S. Geological Survey. Mr. Weed has reduced the former unwieldy volume of nearly 2,000 pages to about 1,400, largely by the elimination of the introductory chapters on mineralogy, geology, mining and metallurgy, and by the segregation of the "dead" companies. The copper mines of North America are now described alphabetically in a first chapter which is followed by a much needed index by states and countries. The third section describes the mines of South America and other continents in alphabetic, non-geographic arrangement. Much new

information is given of copper mines in South America. The book is concluded with a résumé of statistical facts. A wealth of new information is given and much of the descriptive material is entirely rewritten, bringing the book up to date. The policy of frank criticism which has been such a valuable feature of the book in the past is evidently continued and it is safe to say that the "Copper Handbook" in this much-improved form will meet with the approval of those who seek information about the mining of this metal.

W. L.

EIGHTH LIST OF GENERIC NAMES (MAMMALS) UNDER CONSIDERATION IN CONNECTION WITH THE OFFICIAL LIST OF ZOOLOGICAL NAMES

28. Notice is hereby given to the zoological profession that the following list of sixteen generic names in mammals has been submitted to the International Commission to be acted upon under the plenary power authority, granted by the Monaco Congress, to suspend the rules in the Code of Nomenclature. This list is published herewith without comment and all persons interested in the subject are cordially invited to communicate with the secretary of the International Commission and to give him any arguments bearing on the subject.

29. In the following list the names are arranged in the following order: (*a*) preserve; (*b*) for; (*c*) genotype; (*d*) instead of; (*e*) see explanatory notes that follow list.

In accordance with the permission given to zoologists at the Monaco Congress to submit to the International Commission on Nomenclature names which are recommended for fixation by fiat, we the undersigned mammalogists beg to present the following sixteen names which we recommend as *nomina conservanda* in the class with which we are concerned. The general reasons for the presentation of such names have been so often published that we do not need to repeat them here:

(*a*) *Anthropopithecus;* (*b*) for chimpanzees; (*c*) type *A. niger;* (*d*) instead of *Simia* or *Pan;* (*e*) see note T.

(*a*) *Cercopithecus;* (*b*) guenon monkeys of Africa; (*c*) *Simia mona* Schr.; (*d*) *Lasiopyga;* (*e*) T. 1.

(*a*) *Chiromys;* (*b*) aye-aye; (*c*) *Sciurus madagascariensis* Gmel.; (*d*) *Daubentonia;* (*e*) 2.

(*a*) *Coelogenys;* (*b*) paca; (*c*) *Mus paca* Linn.; (*d*) *Agouti* or *Cuniculus;* (*e*) 3.

(*a*) *Dasypus;* (*b*) six-banded armadillo and allies; (*c*) *D. sexcinctus* Linn.; (*d*) *Euphractus;* (*e*) T. 4.

(*a*) *Dicotyles;* (*b*) peccaries; (*c*) *Sus tajacu* Linn.; (*d*) *Tayassu;* (*e*) ?.

(*a*) *Echidna;* (*b*) spiny anteater; (*c*) *Myrmecophaga aculeata* Shaw; (*d*) *Tachyglossus;* (*e*) 5.

(*a*) *Galeopithecus;* (*b*) Philippine colugo; (*c*) *Lemur volans* Linn.; (*d*) *Cynocephalus;* (*e*) T. 6.

(*a*) *Gazella;* (*b*) gazelles in modern sense; (*c*) *Capra dorcas* Linn.; (*e*) T. 7.

(*a*) *Hapale;* (*b*) marmosets; (*c*) *Simia jacchus* Linn.; (*d*) *Callithrix;* (*e*) T. 8.

(*a*) *Hippotragus;* (*b*) sable antelope and allies; (*c*) *Antilope leucophæa;* (*d*) *Ozanna;* (*e*) 9.

(*a*) *Lagidium;* (*b*) mountain chinchilla; (*c*) *Lagidium peruanum* Meyen.; (*d*) *Vizcaccia;* (*e*) 10.

(*a*) *Manatus;* (*b*) manatees; (*c*) *Trichechus manatus* Linn.; (*d*) *Trichechus;* (*e*) T.

(*a*) *Nycteris;* (*b*) the African bats usually so-called; (*c*) *Vespertilio hispidus* Schr.; (*d*) *Petalia;* (*e*) T. 11.

(*a*) *Rhytina;* (*b*) Steller's sea-cow; (*c*) *Manati gigas* Zimm.; (*d*) *Hydrodamalis;* (*e*) 12.

(*a*) *Simia;* (*b*) orangs; (*c*) *Simia satyrus, auct. nec* Linn.; (*d*) *Pongo;* (*e*) T. 13.

Cases marked with a T. involve, under the technical rules, the transfer of a name from one group to another.

Every name here recommended for legalization by fiat is well known to systematists, and universally used by general writers.

When a name is legalized by fiat, we consider that power may be assumed to fix the most classical form of the name, not necessarily that which was first used, *e. g.: Rhytina,*

not *Rytina; Chiromys,* not *Chieromys* or *Cheiromys.*

Purely consequential recommendations (*e. g., Tatu* for the tatous, *Lasiurus* for the American hairy-tailed bats), are not inserted in the list.

Notes to the List

1. *Cercopithecus* has been invariably used for the gueonons up to 1911, and its transfer to the tamarins only depends on Gronovius, a doubtfully binomial writer.

2. *Daubentonia* is almost unknown to general writers, the use of *Chiromys* having been nearly universal.

3. The names objected to are both known in connection with other animals, and the use of either of them for the paca is most confusing.

4. Technically *Dasypus* ought to be transferred to the tatous.

5. *Echidna* has been used by all classes of writers. It would have to be withdrawn from ichthyology.

6. The use of *Cynocephalus* involves a particularly objectionable transfer.

7. An early reference by Pallas in connection with *Oryx gazella* makes it advisable to affix the name *Gazella* to the gazelles before it is attempted to be used for the gemsbucks.

8. The transfer of the name *Callithrix* from the titi monkeys (*Callicebus*) to the marmosets is highly confusing. The name should be dropped altogether.

9. *Hippotragus* has been widely used; *Ozanna* is practically unknown.

10. The use for the mountain chinchillas of *Vizcaccia,* the vernacular name of *Lagostomus,* is most objectionable.

11. By the technical rules *Nycteris* would have to be transferred to the American hairy-tailed bats (*Lasiurus*).

12. *Hydrodamalis* is almost unknown to writers of any class.

13. Specific name (*satyrus*) to be fixed as well as generic, the original *Simia satyrus* Linn. being a chimpanzee.

Signed: KNUD ANDERSON, ANGEL CABRERA, EINAR LÖNNBERG, R. LYDEKKER, PAUL MATSCHIE, OLDFIELD THOMAS, L. L. TROUESSART.

C. W. STILES,
Secretary International Commission

SPECIAL ARTICLES

THE IONE FORMATION OF THE SIERRA NEVADA FOOTHILLS, A LOCAL FACIES OF THE UPPER TEJON-EOCENE

ONE of the numerous problems of California geology is the correlation of the Tertiary (the superjacent series), of the Sierra Nevadas with the Tertiary of the Coast Ranges. Many geologists have written on the age of the auriferous gravels and their associated formations since the time of Whitney, but the age of these formations is still in question and their relation to the marine deposits of the Coast Ranges is unproved.

While collecting during the past two years for the department of paleontology, University of California, the writer has had opportunity for the study of the relationship of the Ione of the Sierra Nevadas with the marine Eocene of the Coast Ranges. His conclusions are based upon visits to four typical Ione localities, viz., Marysville Buttes, Sutter Co., Cal., vicinity of Oroville, South Table Mountain, Merced Falls, and the type locality near the town of Ione in the Jackson Quadrangle.

The conclusion from this study is that the Ione, in part at least, is marine and of Tejon-Eocene age. Marine fossils have been found in the upper portion of the Ione formation at Marysville Buttes, Oroville, South Table Mountain, Merced Falls and Ione. Apparently the same faunal zone, the *Siphonalia sutterensis* zone,[1] is represented.

In the study of the Eocene of the Marysville Buttes the writer's conclusion was that "the supposed marine Ione of Marysville Buttes is evidently Eocene." In the "Note on the Faunal Zones of the Tejon Group," the strata beneath the Older Basalt of Oroville South Table Mountain which Lindgren mapped as Ione, were correlated with the Eocene of the Marysville Buttes. Several of the fossils obtained from the strata beneath the Older Basalt were identical with those of

[1] Dickerson, R. E., "Fauna of the Eocene at Marysville Buttes, California," Univ. of Calif. Publ. Bull. Dept. Geol., Vol. 7, pp. 257–298, 1913. "Note on the Faunal Zones of the Tejon Group," Univ. Calif. Publ. Bull. Dept. Geol., Vol. 8, p. 23, 1914.

the Marysville Buttes. After visiting these two localities the writer was inclined to the belief that the Ione and Tejon had been confused in these places. Conclusive evidence has recently been obtained in the type locality of the Ione which demonstrates that this formation at that place is also merely a local facies of the Tejon-Eocene.

Turner[2] recognized three lithologic members in the Ione at its type locality:

(1) The lower portion, a white clay, resting upon this; (2) a white or red sandstone, and (3), then a light gray, clay rock. He described it as follows:

Along the western border of the metamorphic rocks is a series of nearly horizontally stratified, light-colored sediments, which were deposited in the waters that covered the Great Valley at the time the older auriferous gravels with interbedded pipe-clays accumulated in the river beds of the Sierra slope. This formation attains its maximum development in the area of the Jackson sheet. The lower portion of the series, composed largely of white clay, is well-exposed around Ione, whence the formation takes its name. Farther south the white clays are overlain by sandstone, above which is a fine-grained clay rock. The lower, white clay is in places quite free from grit and is used in making pottery. Other portions are sandy. The formation contains iron-ore and coal seams. The sandstone is used for building purposes. It is usually white, but at one quarry a brick-red variety, colored by finely disseminated hematite, is obtained. At other localities it is rusty and contains pebbles of white quartz, passing into a conglomerate. A peculiar hydrous silicate of alumina occurs abundantly in the sandstone in the form of cream-colored, pearly scales.

The clay rock occurring above the sandstone is light-gray, but usually more or less discolored. The fracture is, as a rule, irregular and the rock frequently contains minute, tubular passages. Under the microscope it is seen to be composed of fine particles of feldspar and fine discolored sediment, with occasional quartz grains. Analyses of two specimens gave 59 and 72 per cent. of silica and 4.8 and 1.6 per cent. of alkali.

The succession of white clay, sandstone and clay rock may not be constant throughout the entire area mapped as belonging to the Ione formation.

[2] Turner, H. W., Jackson Folio, California, U. S. Geol. Surv., p. 2, 1894.

It has been suggested that the white clay of the lower beds are formed from rhyolitic tuffs, in which case eruptions of rhyolite must have occurred at the beginning of the Ione epoch.

The thickness of the Ione formation is known partly by natural exposures, partly by boring. In Jones Butte the strata, protected from erosion by a lava cap, are 200 feet thick above Coal Mine No. 3. A boring at the mine is said to have penetrated sandy clay to a depth of 800 feet below the coal seam, which is 60 to 70 feet below the surface. Thus the Ione beds appear to be more than 1,000 feet thick at this point.

To the east of Buena Vista Peak the series has a visible thickness of 600 feet. The tableland south and southwest of Buena Vista is chiefly composed of the Ione formation, overlain by rhyolitic and andesitic tuff and Neocene shore gravels. The lower clay occurs at the east base of the tableland, and a patch of Ione sandstone caps Waters Peak, a little farther east, which has an elevation of about 900 feet.

The relation of the sandstone to the clay rock is finely exposed on the south side of the Mokelumne River, by the bridge north of Camanche. Here the sandstone forms the lower part of the bank of the river. The upper surface of the sandstone has a gentle westerly dip, and a little west of the bridge reaches the level of the river, which at this point is about 175 feet above sea-level. East of the bridge it rises at an angle of about 1°, reaching an altitude of 1,000 feet on the flat ridge just north of Valley Springs Peak. Along the banks of the Mokelumne west of Lancha Plana this sandstone attains a thickness of more than 100 feet.

Turner in describing the Neocene shore gravels states their relationship to the Ione as follows:

The most striking evidence of nonconformity, however, may be seen at the red sandstone quarry three miles southeast of Buena Vista. Here the Neocene shore gravels rest unconformably on the smooth, waterworn surface of the sandstone, which is red where quarried, but white at the northern end of the exposure. Waterworn bowlders of the white sandstone may be seen in the gravel. Southwest of the quarry the ridge is capped for a distance of more than a mile with the same gravel, which half a mile from the quarry contains a layer of andesitic detritus. At the extreme southwestern end of the ridge is a body of similar gravel, which also rests plainly on sandstone of the Ione formation.

All the localities described by Turner have been visited. At the last-mentioned locality, "the red sandstone quarry three miles southeast of Buena Vista," the writer obtained *Venericardia planicosta* new variety. *Meretrix hornii* Gabb, *Psammobia cf. hornii* (Gabb), *Glycimeris* sp., *Crassatellites* sp., *Turritella merriami* Dickerson, *Natica* sp. and *Clavella* sp. The *Venericardia planicosta* found here is the variety with the obsolete ribs. All of these forms were collected from the sandstone five to ten feet beneath the Neocene shore gravels. While the fauna is limited in species, it is typical of the uppermost, the *Siphonalia sutterensis,* zone of the Tejon. The sandstone member in this vicinity, with a dip of only one degree toward the west, attains a thickness of 250 feet. It rests upon the clay, an altered rhyolitic tuff which is only fifty to one hundred feet in thickness. This in turn rests upon the steeply tilted eastern dipping Mariposa slates of the bed rock series. The same sandstone occurs on the hill east of Buena Vista Peak, and with about the same thickness. A half mile east of this hill the lower clay member becomes appreciably thinner and is only 25 to 50 feet thick. On Waters Peak one half mile further east, the clay member and a good part of the sandstone member are missing and only the massive upper fifty feet of the sandstone member is found resting upon the eroded surface of the Mariposa slates.

The third member, the clay rock recognized by Turner, appears to the writer to be merely a decomposition product of a rhyolitic tuff. A rhyolitic tuff rests directly upon the sandstone member in the vicinity of Buena Vista Peak. The writer's opinion is confirmed by an examination of the strata as exposed in Jones' Butte. A clay rock was found resting upon the sandstone member. In certain places this rock was found to be an unaltered rhyolitic tuff.

From the above description it is seen that this formation appears to have been deposited by a sea which transgressed from the west. Two or more of the three members of the Ione are very persistent over the Jackson Quadrangle, the Lodi Quadrangle, the Sacramento Quadrangle, the Sonora Quadrangle, and they can be recognized readily by their lithologic characters, low westerly dip, and stratigraphic position beneath the andesitic tuffs and upon the Mariposa slates or other members of the bed rock series.

Until these three members were studied at the type locality, the relationship of the small area south of Merced Falls, which was mapped by Ransome and Turner as Tejon, to the adjoining Ione tuffs and clays was obscure. The clays, sand and tuffs exposed one mile west of Merced are lithologically identical with those of the lowermost member, and the red sandstone mapped as Tejon, found here, is identical with that of the second or sandstone member of the Ione of the type locality. The same condition evidently prevailed here as in the area between Waters Peak and Buena Vista Peak, that is, a deposition along the shore line of a rapidly transgressing western sea. In this sandstone, casts of *Cardita planicosta,* var. *hornii,* with obsolete ribs were found near the top. The authors of the Sonora Folio, Messrs. Turner and Ransome[3] describe this as follows:

"*Tejon formation.*—The only rocks referable to this period are a few isolated patches of light-colored sandstone which occur capping some low hills in the southwest corner of the quadrangle. South and southeast of Merced Falls are two level-topped buttes capped by this sandstone, which rests almost horizontally upon the nearly vertical edges of the Mariposa slates. The basal bed is crowded with angular fragments of the slate and with abundant pebbles of white vein quartz, while the upper beds are composed of a light-colored quartzose sandstone with frequent bands of small quartz pebbles. Marine fossils (*Venericardia planicosta*) are fairly abundant in the upper bed at the west end of the butte that lies one mile south of Merced Falls. These sandstones are overlain to the west by the light-colored sandstones of the Ione formation. The two series are probably not absolutely conformable, as the Ione beds transgress onto the rocks of the Bed-rock series farther north."

[3] Turner, H. W. and Ransome, F. L., Sonora Folio, U. S. Geological Survey, p. 2, 1897.

The above-mentioned sandstones, instead of "being overlain to the west by the light-colored sandstones of the Ione formation," are in reality stratigraphically higher. These sandstones have been worn away from most of this area and only a few residuals remain.

After this great erosion, andesitic tuffs and tuff breccias covered all. During the Pleistocene and Recent time much of the andesitic material has been removed re-exposing the older rocks beneath.

The Ione has been repeatedly correlated with the Auriferous gravels of the Sierras and the upper portion with the rhyolitic tuffs. It can no longer be doubted that the Ione is of the same age as the Rhyolitic tuff and the Auriferous gravels, and since the Ione is clearly Tejon-Eocene, the Auriferous gravels, their correlative, must be upper Eocene, at least in part and the land equivalent of the marine Tejon.

Roy E. Dickerson

THE INCREASE IN PERMEABILITY OF THE FROG'S EGG AT THE BEGINNING OF DEVELOPMENT AND THE PRESERVATION OF THE LIFE OF THE EGG [1]

Three years ago, it was observed that the unfertilized frog's egg could be made parthenogenetic by a momentary electric shock, and reasons given for supposing that the electric shock (or the spermatozoon in normal fertilization) increased the permeability of the egg.[2] Recently, I proved this supposition to be correct. The permeability of the unfertilized egg to NaCl was found to have increased on stimulating the egg with an electric shock (which caused it to begin normal development).

Several methods were tried for the quantitative estimation of sodium ions, but the results with such small quantities would not be considered trustworthy had they not tallied with the more certain results on the determination of chlorine ions with the nephelometer, and only the latter will be described here. The technique was as follows:

A "pregnant" female of *Rana pipiens* was washed in alcohol and then in water, pithed and opened. The eggs were removed from the oviducts without mechanical injury or contamination with blood or lymph. These eggs were washed 10 minutes in a large volume of H_2O[3] and divided into two exactly equal masses. Each mass was placed in 30 c.c. of H_2O and allowed to remain for 30 minutes while the jelly swelled. The water that had not been taken up by the jelly was analyzed and the Na+ and Cl— found to be the same for both lots. Then lot 1 was stimulated by an electric shock from clean platinum electrodes[4] and lot 2 used as a control. 20 c.c. of H_2O were added to each lot and at the end of one hour this water was analyzed. There was more Na+ and Cl— in the water from the stimulated eggs than the control, the ratio of Cl— being 10 to 7. This is a very small difference, but it must be remembered that the salt in diffusing out of the egg is held for some time by the "fertilization membrane" and the thick jelly surrounding the egg. Consequently 30 c.c. of H_2O were added to each lot and allowed to remain eight hours to give time for the salts to diffuse through the jelly. There was now found three times as much Cl— that had diffused out of the stimulated eggs as had diffused out of the control. Whether this increase in permeability is the *cause* of development has not been determined, but it is not restricted to the frog's egg, since I found the same true of the sea urchins' egg,[5] a fact which has been confirmed by Gray[6] at Plymouth.

The unfertilized frog's egg placed in fresh or distilled water continues to swell until death ensues. This death is probably caused by the swelling, and the latter by the osmotic pressure of the soluble substances contained within

[1] Preliminary note.

[2] McClendon, Science, N. S., Vol. 33, p. 629.

[3] H_2O means water redistilled in quartz.

[4] In about one minute all of the eggs had turned the black pole upward; 3 hours later the first cleavage began.

[5] McClendon, *Amer. Jour. Physiol.*, 1910, Vol. 27, p. 240.

[6] Gray, *Jour. Marine Biol. Assn. U. K.*, 1913, Vol. 10, p. 50.

the egg. The increased permeability allows the escape of NaCl and lowers the internal osmotic pressure, thus retarding the swelling and preserving the life of the egg.

The decreased swelling of the developing egg can easily be measured. Forty-six eggs were removed from the oviduct and 23 placed on the bottom of a dry glass dish and 23 in a similar one. They were covered with distilled water and the first lot stimulated with an electric shock[7] and the second lot used as a control. The longest and shortest diameter of each egg was measured and the mean of all of each lot determined. The mean diameter of the eggs of the first lot on an average of 30 minutes after stimulation was 1.47 mm., whereas the mean diameter of the control was 1.52 mm. This is in confirmation of the results of Biataszewicz and of Bachmann. Biataszewicz[8] says that the frog's egg momentarily shrinks immediately after fertilization, due to fluid passing out of the egg into the perivitelline space. This is probably due to the increase in permeability. The quantity of fluid in the perivitelline space immediately after fertilization is too small to be collected, but it accumulates during development due to absorption of water from the medium and finally can be removed with a very fine thin-walled capillary pipette. Bachmann thinks that the osmotic substances in this fluid are secreted by the suckers, but the fluid is more abundant in *Amblystoma,* which has no suckers. I found it to contain relatively large quantities of NaCl, considering the fact that the "fertilization membrane" is permeable to NaCl. In *Amblystoma* this fluid is in such abundance that one might hope to make a complete analysis. I found it to contain besides water and NaCl, an organic substance which greatly reduced the surface tension. A very slight Millon's reaction was obtained after evaporating the solution down to dryness. Although the perivitelline space is larger in eggs in distilled water than in tap water, after the space has once enlarged, it is not readily shrunken by salts in the medium. The diameter of the "fertilization membrane" of an egg taken from distilled water was 13 mm. It was placed in Ringer's solution (for mammals) and in two days it had decreased only to 11.5 mm.

Bachmann and Runnström[9] found that the osmotic pressure of the frog's egg dropped enormously on fertilization and they do not believe that this can be accounted for by loss of salt. They seem to consider the egg as a diphasic system in which the watery phase forms the main bulk of the egg. On the contrary, the frog's egg is a four-phase system in which the watery phase is a very small fraction of the total volume. The bulkiest phase consists of yolk platelets composed of lecithalbumin swollen with water. The oil droplets are small and pigment granules smaller. It seems probable that the watery phase, which I found to contain 85 per cent. water and which fills the interstices between the other bodies, would freeze first in freezing point determinations, and we may assume that Bachmann and Runnström determined the Δ and calculated the osmotic pressure of this phase. Since the watery phase is but a small fraction of the volume of the entire egg, the loss of only a minute quantity of NaCl would be necessary in order to greatly lower the osmotic pressure. It should also be noted that Bachmann and Runnström did not remove all of the jelly from the eggs before crushing and freezing them and, consequently, the calculated osmotic pressure for the fertilized eggs is probably too low. The unfertilized eggs which they used were taken from the ovary and were not surrounded by jelly.

Bachmann and Runnström suppose the reduction of osmotic pressure of the frog's egg on fertilization to be due to the adsorption of salts to the proteins, following a sort of "coagulation" of the proteins. If it is true that the salts are adsorbed after "coagulation" by fertilization, we might suppose that they would be adsorbed after coagulation by heat, which could be tested by experiment. 564

[7] The first lot rotated normally and, 3 hours later, began the first cleavage.

[8] *Bull. Acad. Sc. Cracow Math.-Nat.*, October, 1908.

[9] *Biochem. Zeitschr.*, 1909, Vol. 22, p. 390.

grams (about 50 c.c.) of ripe ovarian eggs of *Rana pipiens* were boiled in absolute alcohol and extracted with absolute ether and dried at 135°. They were then powdered and boiled in 200 c.c. distilled water slightly acidulated with acetic acid (free from salts) to coagulate the proteins, and filtered. The filtrate was evaporated down and both filtrate and precipitate charred and extracted and titrated for chlorides. The filtrate required 1.55 c.c. 1/10 normal $AgNO_3$, whereas the precipitate required but .2 c.c., which might be due to the small amount of filtrate held in the precipitate. It thus appears that very little if any salt was adsorbed. If all this chloride is NaCl it would make a .00756 molecular solution of the same volume as the egg. However, the osmotic pressure of the ovarian egg corresponds to that of a .166 normal NaCl solution. If this osmotic pressure is due chiefly to NaCl it must be confined to the watery phase which must equal .0455 or about 1/20 of the volume of the egg.

I found that frog's eggs lose NaCl continuously during their development in distilled water, hence they must be permeable to NaCl for some time after fertilization. This is in harmony with the fact that pure NaCl solutions are not so toxic to the frog's egg as to the eggs of many other animals. I found that those salt solutions which were toxic to fish eggs increased the permeability, but the fertilized frog's egg is already permeable.[10] Some of the older work on the effect of pure NaCl on the frog's egg might be objected to on the ground that the NaCl solution became contaminated by Ca contained in the egg jelly. Therefore I made a series of experiments in which small numbers of frog's eggs were washed for an hour in several liters of distilled water, and placed in several liters of pure $NaNO_3$ solution. Very dilute solutions were non-toxic. One tenth molecular solutions showed a toxic effect in 48 hours, but this may have been due to osmotic pressure, since the addition of 1.6 c.c. of a molecular $CaCl_2$ solution to the liter did not decrease the toxicity. The toxicity of all salts is not due entirely to osmotic pressure, since I found lithium salts to be slightly more toxic than sodium salts of same osmotic pressure.

All of the abnormalities in the lesser toxic salt solutions which I have observed or found in the literature, are characterized by a retardation or failure of the white pole to segment. This is also true of abnormalities produced by centrifugal force or other mechanical agents applied to the unsegmented egg. This unsegmented white pole prevents or retards the downgrowth of the black cell layer, and in extreme cases leads to the so-called "lithium larvæ." These embryos may regenerate and become normal tadpoles. The more toxic solutions prevent segmentation of the white pole and cause swelling of serous cavities (pericardium) and a separation or loosening up of the black cells, accompanied by death of some of these cells (a condition called by Roux "framboisea"). This condition (also seen in fish embryos) occurs after the frog's embryo has partially regained its semipermeability, and may be due to an abnormal increase in permeability by the salt solution.

J. F. McClendon
Physiological Laboratory,
Medical School,
University of Minnesota,
June 1, 1914

[10] Although it is more permeable to water than to salts.

THE AMERICAN CHEMICAL SOCIETY. III

Division of Physical and Inorganic Chemistry

G. A. Hulett, Chairman
R. C. Wells, Secretary

Rapid Detection of Arsenic in Poison Cases by the Marsh Test: James R. Withrow.

It seems to have been the experience for a long time that the number of cases where arsenic is the poison used exceeds that of all other poisons combined. Certain and rapid detection is therefore a matter of much moment. Any effort to make old methods more certain and to eliminate possibility of error by contamination or to abbreviate, thus reducing opportunity for loss, are desirable. The Berzelius-Liebig modification of the Marsh test (1836) has long enjoyed confidence as one of most satisfactory tests. It requires for universal certainty of results the elimination of organic

matter. This is slow, tedious and furnishes much opportunity for loss or contamination. The Reinsch test (1841) is rapid and simple, using the minimum of added reagents. In its present form its results are uncertain and seldom removed from the region of doubt. It does not require the preliminary removal of organic matter. The present work is believed to have made the detection of arsenic much more certain by eliminating entirely the destruction of organic matter. The arsenic is secured on copper strips as in the usual Reinsch procedure. These strips are introduced into a "duplex" Marsh apparatus which has been devised in this work. By the "duplex" feature (two hydrogen generators) no arsenic is lost while displacing air from the generator containing the copper strips which possibly contain arsenic. The use of two generators can be dispensed with by introducing an extra reagent to dissolve the arsenic from the copper. Either procedure greatly reduces the time necessary for the detection of arsenic with all the precision of Marsh's method. The new procedure has already been tried with thorough satisfaction in two poisoning cases where the presence of arsenic was proven finally to be present by the older procedures. The new procedure consumes but an hour or two where the old ones consumed usually one or more days.

The Decomposition Voltages of Salts in Liquid Ammonia. I. The Ammonium Salts: H. P. CADY AND C. A. NASH.

Adsorption and Stabilization: J. C. BLUCHER AND E. F. FARNAU.

Further experimental facts are adduced to substantiate Bancroft's stabilization theory of dyeing. These include examples of adsorption of dyestuffs and inorganic compounds on colloidal hydrous aluminium-, copper- and cobalt-oxides.

The Ideal Diffusion Coefficient and a New Fundamental Law of Diffusion: G. MCP. SMITH.

Further Observations on the Preparation of Selenic Acid and Selenates: PHILIP L. BLUMENTHAL.

A Burette Calibrating Pipette: E. C. FOULK.

Preparation of a Standard Magnesium Salt Solution: E. C. FOULK AND O. R. SWEENEY.

Concerning the Atomic Weights of Carbon and Sulphur: THEODORE W. RICHARDS AND C. R. HOOVER.

In order to verify the silver-halogen standard of atomic weights by reference to a ratio entirely different, a precise quantitative comparison was made between sodium carbonate and silver. The purest sodium carbonate was fused in a stream of carbon dioxide. It was then with all possible care analyzed exactly with very pure hydrobromic acid, and the amount of silver needed to precipitate the bromine was determined as well as the weight of silver bromide. For every 10.59950 grams of sodium carbonate 21.5760 grams of silver were needed. Hence carbon according to the International Standard of Atomic Weights became 12.005, sodium being 22.995. If silver is taken as 107.871, carbon became exactly 12. These results are completely concordant with the usually accepted values concerning carbon and silver. The agreement is striking and affords a much-needed and very welcome confirmation of the whole fabric of our table of atomic weights. The investigation was continued by converting weighed amounts of the purest sodium carbonate into sodium sulphate. The results were concordant among themselves, but pointed to a somewhat smaller atomic weight of sulphur than that usually recognized, namely, 32.055, if silver is taken as 107.88. This research verifies in a striking way that published by one of the authors, twenty-four years ago. The technique of this work will be of great value to any one desiring to make exact acidimetric or alkalimetric analyses.

The Critical Point and the Significance of the Quantity b in the Equation of van der Waals: THEODORE W. RICHARDS.

In this paper many results (especially those of Kamerlingh-Onnes) were quoted to show that the apparent bulk of the molecules of gases must be supposed to change according to circumstances. It was pointed out that the magnitude and direction of this change is such as would be expected if the molecules and atoms are compressible, but, if this is the case, the reasoning of van der Waals, which infers that the bulk of the molecules is only one quarter of *b*, is no longer sound, for this reasoning assumes the incompressibility of the molecules. The present argument shows rather that the actual bulk of the molecules when uncompressed by collision or by the compressing effect of affinity must be much larger than has been supposed, indeed larger than the actual bulk of the liquid under ordinary conditions, and perhaps that assumed at the critical point. It was pointed out that the continuity between the liquid and the gaseous states may be supposed to exist, if at all, only at the critical point, and that the application of the equation of van der Waals to liquids is of doubtful significance. The critical temperature is defined by supposing that it is the point where

the kinetic vibrational energy of the molecules is just barely enough to separate them when the outside pressure (added to their own affinity) is just sufficient to bring, on the average, the molecular surfaces into contact. In conclusion, it is clear that this interpretation of these facts is in complete accord with the theory of compressible atoms. Indeed, the various phenomena concerned seemed to be thus explained better than in any other way.

The Present Status of the Absolute Standard of Pressure: Theodore W. Richards.

The object of this paper was to point out the fact that the absolute or C. G. S. standard of pressure is being more and more used by those actually having to do with the pressure-measurement. Various meteorologists, chemists, physicists and engineers are using it regularly; the United States Weather Bureau, the Blue Hill Observatory, and the Weather Office in England are adopting it as their method of recording atmospheric pressures for scientific study. There is still some conflict in nomenclature, but it is to be hoped that the proposal adopted by the International Congress of Physicists, at Paris, in 1900, and independently suggested by the writer, that the "absolute atmosphere" (or the pressure of a megadyne per square centimeter) should be called the "megabar" or "megabarie," will be generally adopted. This "absolute atmosphere" is 1.3 per cent. less than the old atmosphere, and is the pressure exerted by a column of mercury 750.1 centimeters high at 45° latitude and 0° Centigrade.

A Method for Producing a Reproducible Contact Potential between Liquids: E. P. Schoch.

The Relation between the Concentrations and the Potential of the Ferrous-ferric Pole: E. P. Schoch. (Lantern.)

New Electro-analytical Methods for Lead, Tin, Copper and Antimony: E. P. Schoch and D. J. Brown. (Lantern.)

Contribution to the Knowledge of the Actinium Series: Herbert N. McCoy and Edwin D. Leman.

Solutions of Some Formates and of Hydrogen Chloride in Anhydrous Formic Acid-gases of Apparent Agreement of Strong Electrolytes with the Mass Law: H. I. Schlesinger and A. W. Martin.

When the degree of ionization of solutions of sodium, of phenyl-ammonium, of potassium and of ammonium formates in anhydrous formic acid is calculated from the conductivities of these solutions, the values agree very closely with the equilibrium law up to concentrations, varying from 0.3 to 0.55 molar in the several cases. These electrolytes are highly ionized in this solvent, as shown by the ionization constants, which are 0.75, 0.74, 0.95, 1.15 for the salts in the order in which they are named. Hydrogen chloride also agrees with the law; its constant is 0.04. When the conductivities are corrected for the viscosity of the solution the agreement with the law is not found.

Vapor Tensions in Alcoholic Solutions: O. F. Tower and A. F. O. Germann.

This is a continuation of the work published in the *Journal* of the society, 1908, p. 1219. Vapor pressures were measured exactly as described in that paper by means of the Morley gauge. The new feature is the preparation of the solutions entirely out of contact with air. Methyl and ethyl alcohols were used as solvents, and, after being purified and then fractionated *in vacuo*, were distilled directly on to the solute. Potassium iodide, lithium chloride, benzil and tetramethylammonium iodide were the solutes employed. Curves drawn with the concentrations as abscissas and the lowering of the vapor tension as ordinates are fairly regular, those of the salts rising more rapidly with the increase in concentration than those of the organic solutes. The molecular weights of the latter, as calculated, are approximately normal, while those of the salts are about one half the formula value and do not vary much with the concentration. The work is being continued to see whether this last statement is confirmed by further experiments.

Arsenious Oxide as a Starting Material in Acidimetry: Alan W. C. Menzies and F. N. McCarthy.

Equilibria in the Systems, Water, Acetone and Inorganic Salts: Geo. B. Frankforter and Lillian Cohen.

An investigation is made of the isotherms at 20° of the systems, water, acetone salts. The salts used are KF, K_2CO_3, $CaCl_2$ and NaCl. The comparative efficiency of these salts in "salting" out acetone from an aqueous solution is determined. KF is the most and NaCl is the least efficient. The amount of acetone present in an aqueous solution can be determined by the formation of layers when the potassium fluoride is added to the solution. Within certain limits methyl alcohol acts as if it were water and will not interfere in this determination.

The Colorimetric Determination of Manganese by Means of Periodate: H. H. WILLARD AND L. H. GREATHOUSE.

The solution of manganese salt containing excess of nitric, sulfuric or phosphoric acid is boiled for a minute after addition of potassium periodate. The manganese is oxidized to permanganic acid, the periodic acid being reduced to iodic acid. Small amounts of hydrochloric acid are without influence, being quickly oxidized to chlorine. The concentration of acid above a certain minimum may be varied within wide limits. In the presence of iron, sulfuric or phosphoric acid must be present to prevent the precipitation of ferric periodate. By means of a colorimeter, the solution is compared with a standard similarly prepared.

Electromotive Behavior of Soluble Sulfides: R. C. WELLS.

From a study of the potentials shown by various solutions of sulfides with a platinum electrode it was concluded that the electromotive behavior of the polysulfides depends on the relative proportions of the sulfides present, but that in acid solutions where free sulfur is apparently the only oxidation product of sulfide ions the potential of solutions which are very slightly oxidized can be expressed by the equation

$$E = -0.26 - 0.029 \log[s^{--}],$$

since the concentration of the free sulfur is constant and equal to its solubility in water.

The Phase-rule Investigation of Addition Reactions: JAMES KENDALL.

The freezing-point modes of the two-component system dimethylpyrone-acid have been examined for a large number of organic acids and phenole. The existence of thirty-seven addition compounds has been demonstrated. The results obtained are discussed in their bearing on the constitution of dimethylpyrone and the quadrivalence of oxygen. The reaction is considered to be ionic, and the compounds formed to be true oxonium salts. The method is generally applicable to the study of organic addition reactions.

Peculiar Action of Iodine: CHARLES T. P. FENNEL.

Distribution of Caffeine and Antipyrin Between Chloroform and Aqueous Solutions: W. O. EMERY AND C. D. WRIGHT.

Reaction in Non-aqueous Solvents: O. L. BARNEBEY.

Separation of Potassium from Sodium by Extraction of their Chlorplatinates with Acetone: O. L. BARNEBEY.

Some Compounds Belonging to the Ammonia System of Acids, Bases and Salts: E. C. FRANKLIN.

(1) *The Action of Potassium Amide on the Amides of Silver, Barium, Strontium, Calcium, Lithium and Sodium.* By Edward C. Franklin. It will be recalled that the writer and his collaborators have prepared compounds of the formulas,

$Sn(NK)_2 \cdot 4NH_3$, $Zn(NHK)_2 \cdot 2NH_3$, $PbNK \cdot 2\frac{1}{2}NH_3$ and

$$N \equiv Ti - NHK,$$

to which, in view of the analogy existing between these compounds as derivatives of ammonia on the one hand, and the stannate, zincate, plumbite and titanate of potassium as derivatives of water on the other, have been given the respective names, potassium ammonostannate, potassium ammonozincate, potassium ammonoplumbite and potassium ammonotitanate. Furthermore it will be remembered that similar ammono salts containing thallium and magnesium have been prepared, an accomplishment which is noteworthy in view of the fact that the corresponding aquo salts are unknown. It now appears that not only are the above-mentioned salts formed in a manner similar to that used in the preparation of potassium ammonozincate but that also the amides of silver, barium, strontium, calcium and even lithium and sodium enter into reaction with potassium amide in solution in liquid ammonia to form sharply defined products of the respective formulas,

$AgNHK \cdot NH_3$, $BaNK \cdot 2NH_3$, $SrNK \cdot 2NH_3$,

$CaNK \cdot 2NH_3$, $LiNK_2 \cdot 2NH_3$ and $NaNK_2 \cdot 2NH_3$. If the compound, $Zn(NHK)_2 \cdot 2NH_3$, is properly designated as potassium ammonozincate, and it certainly is if the compound $Zn(ONa)_2 \times H_2O$, is called potassium (aquo) zincate, then these new compounds must receive the respective names, monopotassium ammonoargentate, monopotassium ammonobarate, monopotassium ammonostrontiumate or strontianate, monopotassium ammonocalciumate or calcate, dipotassium ammonolithiumate (or possibly lithianate) and dipotassium ammonosodiumate (or sodate or natronate). This procedure is of course pushing analogy to the limit and it may be that these products are not salts at all, but are molecular compounds as represented by the formulas

$$AgNH_2 \cdot KNH_2,\ Ba(NH_2)_2 \cdot 2KNH_2,$$
$$NaNH_2 \cdot 2KNH_2,$$

etc., whatever the significance of such formulas may be. The writer hopes, by transference meas-

urements, to be fortunate enough to determine whether or not such a substance as $NaNK_2 \cdot 2NH_3$, for example, in solution in liquid ammonia dissociates into NaN anions and K cations, though it may well turn out that such experiments will show no results because of ammonolytic decomposition of the salt, for certainly if acid at all sodium amide must be a very weak one.

(2) *The Action of Potassium Amide on Cadmium, Nickel and Chromium Salts in Liquid Ammonia Solution.* By E. C. Franklin and George S. Bohart. Experience in this laboratory has shown that metallic amides, imides or nitrides are precipitated when a liquid ammonia solution of the ammono base, potassium amide, is added to similar solutions of the salts of heavy metals. It has also been found when the precipitant is added in excess that, in many cases, compounds are formed which are related to ammonia as the zincates and aluminates are related to water. (*Cf.* preceding abstract.) Following the procedure thus indicated the amides of cadmium and nickel, $Cd(NH_2)_2$ and $Ni(NH_2)_2$, have been prepared, both of which may be deammonated and thus converted into the corresponding nitrides, Cd_3N_2 and Ni_3N_2. It has also been shown that compounds of the second class indicated above are formed when potassium amide is added in excess to solutions of the sulfocyanates of cadmium, nickel and chromium. The products obtained have the composition represented by the empirical formulas, $CdN_4H_8K_2$, $Ni_2N_9H_{18}K_5$ and $Cr_2N_8H_{15}K_3$. Some light is thrown upon the nature of these compounds if they are formulated as follows:

$$Cd(NHK)_2 \cdot 2NH_3, \text{ or } Cd(NH_2)_2 \cdot 2KNH_2,$$

$$K_2NNi—NK—NiNK_2 \cdot 6NH_3$$

or

$$2Ni(NH_2)_2 \cdot 5KNH_2,$$

and

$$KN{=}Cr—NK—Cr{=}NK \cdot 5NH_3$$

or

$$(NH_2)_2Cr—NH—Cr(NH_2) \cdot 3KNH_2.$$

They may receive the respective names; potassium ammonocadmiate (or cadmate), potassium ammononickelate and potassium ammonochromate. When potassium nickel cyanide is treated with potassium amide one of the three complex compounds of the respective formulas,

$$Ni_3N_2H_2K_4(CN)_6 \cdot 8NH_3$$

(which loses ammonia to form $Ni_3N_2H_2K_4(CN)6_2$), $NiNHK_2(CN)_2$ and $Ni_3N_{11}H_{22}K_7(CN)_2$, is formed depending upon the relative quantities of the nickel salt and potassium amide used. We are unable to assign rational formulas to these compounds. Formulation as follows, however, furnishes some clue to their nature.

(1) $K_2(CN)_3Ni—NH—Ni—NH—Ni(CN)_3$
$K_2 \cdot 8NH_3$

or

$$K_4Ni(CN)_6 \cdot 6NH_3 \cdot 2Ni(NH_2)_2.$$

(2) $K(CN)_2NiNHK$

or

$$K_2Ni(CN)_4 \cdot Ni(NHK)_2.$$

(3) $(CN)Ni—NK—Ni—NK—Ni$
$(CN) \cdot 5KNH_2 \cdot 4NH_3.$

Number 1 is a mixed potassium nickel cyanide-nickel amide or imide. Number 2 is a mixed potassium nickel cyanide-potassium ammononickelate, as is also number 3.

Gas Analyses by Liquefaction and Fractionatives and the Condition of Natural Gas in the Earth's Strata: G. A. Burrell and Frank M. Seibert.

The exact composition of natural gas such as is used in Pittsburgh, Pa., Cincinnati, Ohio, and many other cities is shown for the first time. As a result of this work it is shown that these gases are accumulated in their deposits in the gaseous condition, and not as liquids. If present therein as liquids it would be possible for single small subterranean reservoirs to hold much larger quantities of gas than they now do.

The Condition of Natural Gas in the Earth's Strata: G. A. Burrell and Frank M. Seibert. (Lantern.)

Collisional and Diffusional Viscosities: Eugene C. Bingham.

Heat and Chemical Energy of Molecules, Atoms and Subatoms: J. E. Siebel.

Electrostenolysis: Harry N. Holmes.

By electrostenolysis is meant the deposition of a metal or its oxide in very fine capillaries when the solution filling these capillaries is electrolyzed. Braun and Coehn experimented only with cracks in glass tubes. The author improved this method by the use of capillary membranes in the form of glass tubes packed with finely powdered substances such as glass, sulfur and silica. This multiplies greatly the capillary surfaces and permits the use of many different membranes. Working with tubes so prepared, the author added a number of examples of electrostenolysis to the list recorded by Braun.

Charles L. Parsons,
Secretary

(*To be concluded*)